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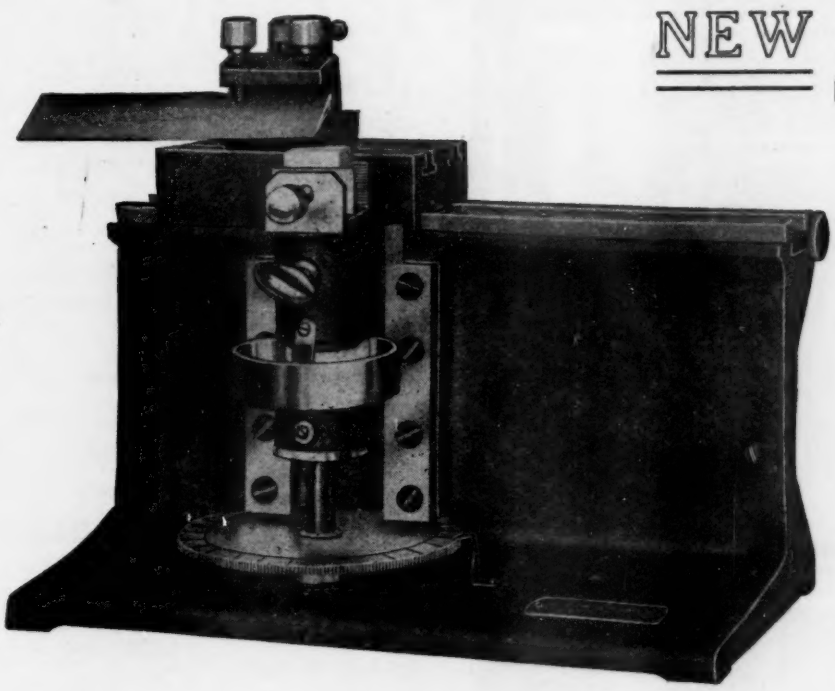

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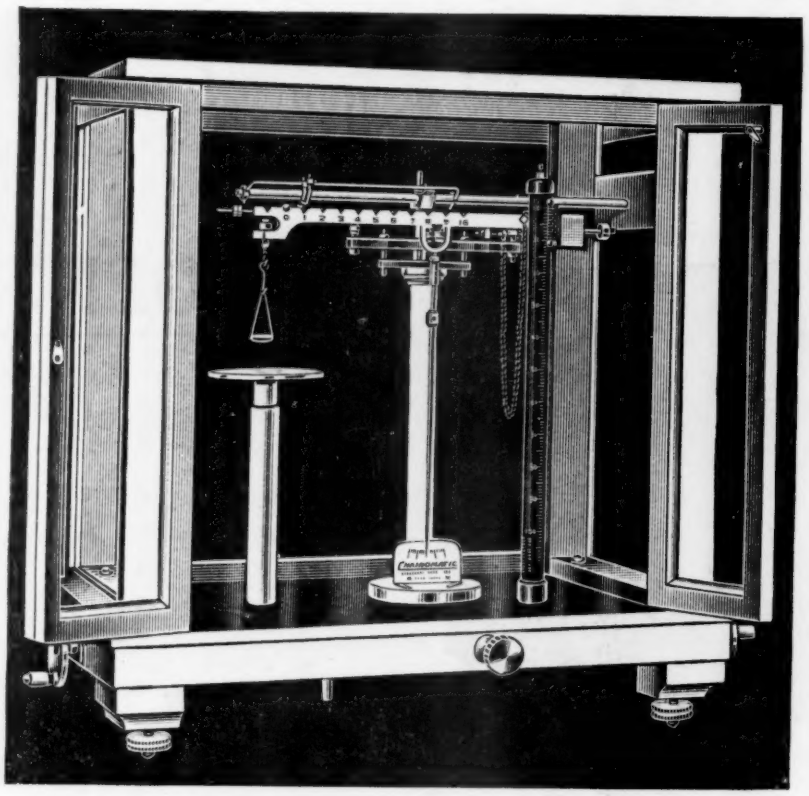

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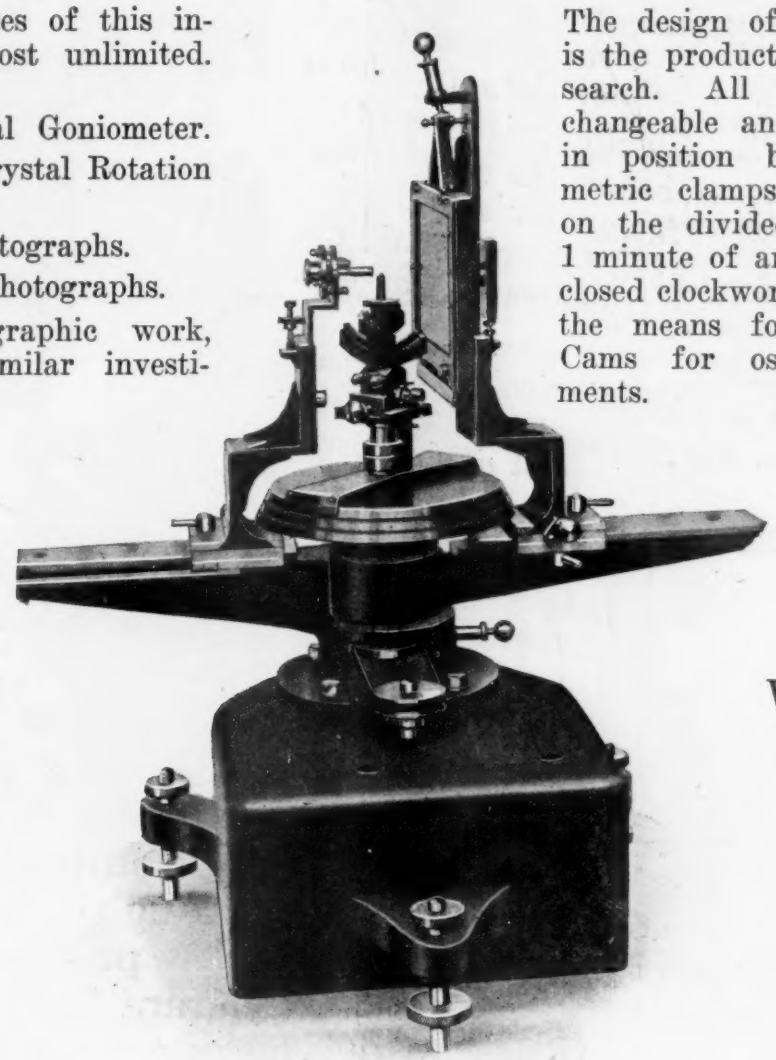

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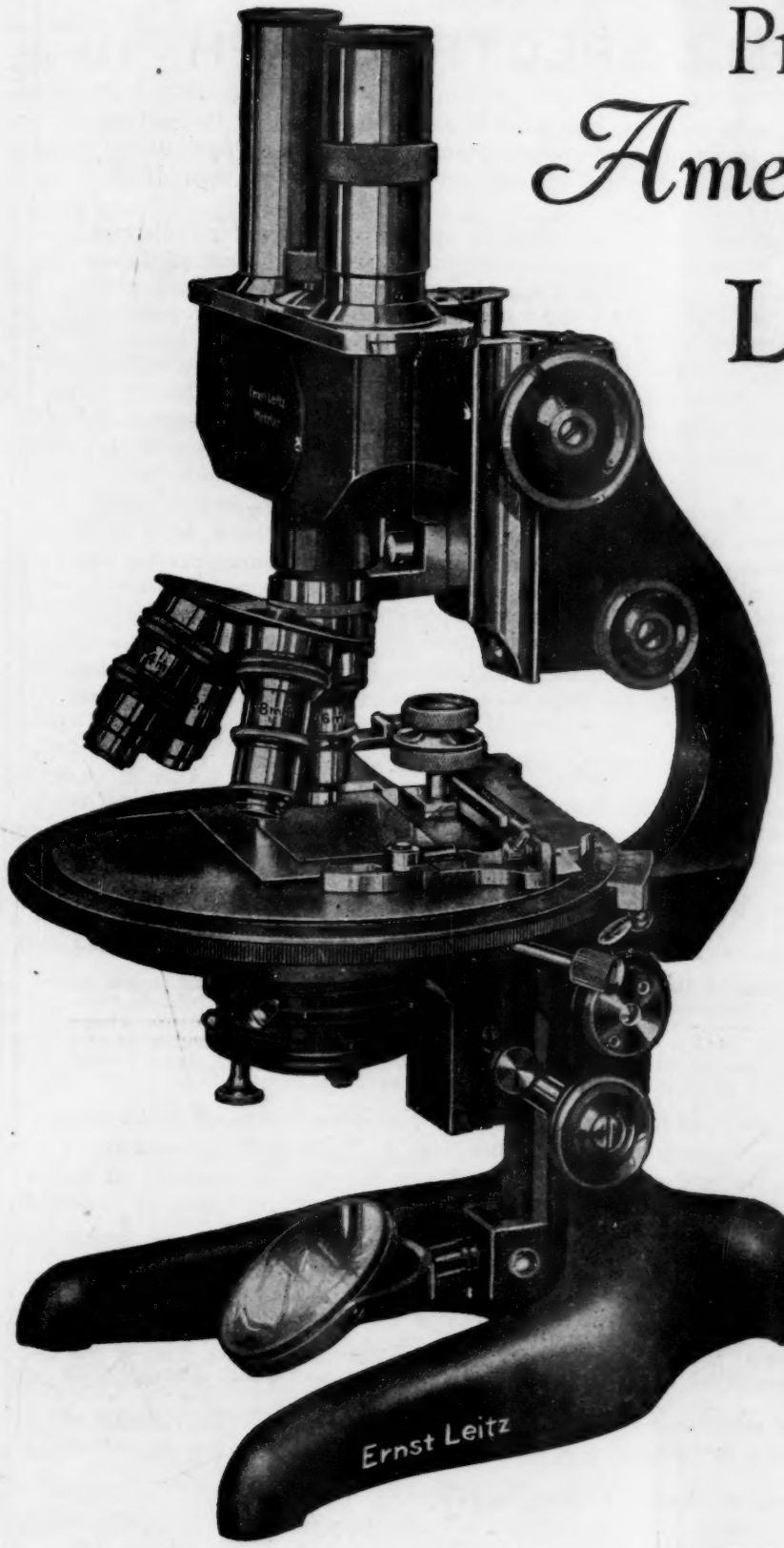

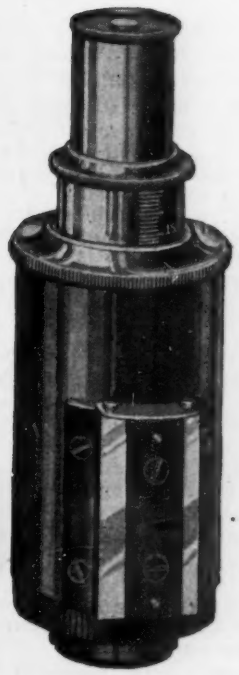

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SURFACE STRUCTURE AND ATOM BUILDING[1]

By Professor W. D. HARKINS

UNIVERSITY OF CHICAGO

I. INTRODUCTION

I WISH to express my great appreciation of the unexpected honor which is conferred upon me by the award of the Willard Gibbs medal, established through the generosity of William A. Converse, and bestowed by a jury chosen from the American Chemical Society. For many years Gibbs has been one of my heroes of science, and I am very proud to have my name associated with his in this way. As you know, he was the greatest of American chemists without being, in the technical sense, a chemist at all. The student of chemistry who shies at mathematics may well take this fact into account, for Gibbs at his desk discovered in a few years more concerning the relations of chemical phenomena than has been learned in the whole life work of dozens of other prominent chemists.

The number of facts which may be found in experimental work in any science is so great, and at the same time so limited in scope, that their discovery is seldom worth while unless they can be correlated with other facts to give general relations. The most general of these relations are often dignified by their designation as laws of nature. Thus scientists may be classified as those who discover facts and those who classify or correlate them, or as experimentalists and theorists. Usually the experimentalist needs to be, at least in a limited way, a good theorist, though it is not essential that the theorist be an adept in experiment. For this reason, Gibbs was able to become the greatest of theoretical chemists without the acquisition of any of the ordinary experimental technique of the science.

[1] The Willard Gibbs lecture delivered in connection with the award of the Willard Gibbs gold medal by the Chicago Section of the American Chemical Society, May 25, 1928. Revised May 18, 1929.

Arrhenius, the first Gibbs medalist, established the precedent of describing his own work, and the factors which caused him to take up the specific topics of research which he had undertaken, and it has been requested that I should follow his lead, though it will be necessary to do so in a more limited way.

As an undergraduate, research appealed to me as one of life's greatest adventures, and I was attracted both to the very large, in astronomy, and to the extremely minute, in chemistry and physics. While the study of the atom and of radioactivity, then a new subject, had an extreme fascination, there were two subjects of investigation in physical chemistry which seemed to me of such minor importance that I took a firm resolution never to be enticed into working on either of them.

These two fields of work were surface tension and solubility. To illustrate, let us consider surface tension. I did not realize that the importance of the study of surfaces and surface energy arises from the fact that the surface lies outside every body, particle or cell. To get inside from outside or outside from inside, the surface must be traversed.

In 1909 I went to Germany to study with Haber, the chemist whose work on the synthesis of ammonia lengthened the World War by one or two years. On the first day of my stay in Karlsruhe, he invited me to lunch with him and his assistant at the leading hotel of the city.

Haber insisted that as a visiting professor—I was then professor of chemistry at the University of Montana—only a problem of extreme importance should be given to me. He and his assistant rose, drank my health, and Haber said, "He shall work on surface tension." Unfortunately, or fortunately, I knew hardly enough German to object, and when much later I found that many of the world's greatest scientists had been interested in surface phenomena, I was thankful for this lack of knowledge. Thus Gibbs himself, Laplace and Newman, Einstein, of relativity fame; Roentgen, the discoverer of X-rays; Sir William Ramsay, Lord Rayleigh, T. W. Richards, Bohr, Mendeleeff, van der Waals, Debye, Poincaré, the great mathematician, Walden, Guye and Maxwell —all these had an extreme interest in surface phenomena.

The idea of the problem suggested was that by the investigation of certain surface tension phenomena in extremely simple systems we might make more plausible the idea that the motion of the muscles is due to changes in surface tension of the fibrilles of the muscles, as related to practically simultaneous chemical and electrical changes. This idea seemed well supported by certain simple work done in Nernst's laboratory, but not by Nernst himself. My own experiments showed, however, that this work was altogether incorrect, and so the special point of view that such an extremely simple system could properly represent the mechanism lost its usefulness.

After the completion of the experimental work, I returned to America in order to work on physical chemistry with A. A. Noyes and G. N. Lewis, both of whom have been awarded the Gibbs medal. Here I met my second aversion, for A. A. Noyes stated that, under the grant from the Carnegie Institution which supported the work, it was expected that the general subject of research should be the theory of solutions, but the special subject solubility.

Now the greatest of solubility rules is "similia similibus solvuntur" or "like dissolves like." This rule suggested that the experiments on surface tension might have given results more in accord with the theory if more complicated molecules, such as those present in the muscles, had been used. It is advisable, however, in scientific work, to use as simple materials as will give the desired behavior, so substances like butyric acid were considered. Butyric acid is the substance which gives the disagreeable odor to rancid butter, and a molecule of this substance possesses the interesting characteristic that at one end it is like oil, and at the other like water.

Thus we may place a thick layer of oil on water and add butyric acid. The water-like ends of the molecules should be soluble in water, and the oil-like ends in the oil, but only at the interface between the two can both ends of the molecule be satisfied at the same time. From this point of view the butyric acid should be very much more soluble at the interface than in either oil or water, which is true. Furthermore, at the interface there should be a certain structure, since the molecules of butyric acid should, in general, be oriented with oil-like ends toward the oil, and water-like ends toward the water. (Orientation at a surface was here illustrated by throwing on the surface of water a large number of cylinders of wood, weighted at the red end, which represents a polar group, and white at the lighter or non-weighted end, which represents the non-polar groups.

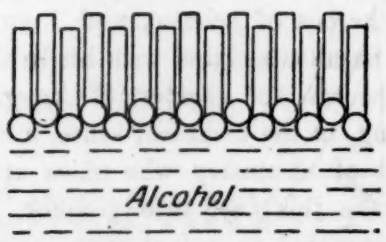


FIG. 1A. Orientation of the molecules at the surface of a liquid.

All these cylinders took on an upright position in the surface of the water, with the red ends down and the white ends up. The molecules differ in that they

are in motion, so their orientation is not complete.)

A later careful search in the literature showed that Hardy, a noted English biologist, had just suggested (1912) that since a surface is extremely unsymmetrical with reference to the material on its two sides, the molecules in the surface should be oriented. Thus the theory of dissymmetry and that of solubility gave rise in two different minds to the same suggestion. Hardy suggested as an additional hypothesis that this molecular orientation should result in the attraction or repulsion of their surfaces according to the way in which the molecules are oriented. With this hypothesis, I was not so much in accord, and work was begun to show that the surfaces always attract, and that the variation in the magnitude of the attraction indicates that the molecules are oriented.

It was found that when alcohol, for example, is pulled apart it is separated at the weakest place in the liquid. That is, the final break seems to occur between the oil-like ends, and not between those that are water-like. Furthermore, when alcohol evaporates, the oil-like ends emerge first from the surface and the water-like ends escape last. Several years later this last idea led to the discovery of a new method of testing experimentally the symmetry of the molecules of a substance in the surface of a liquid.

It is of much interest to me that one of the speakers this evening, Dr. George L. Clark, while in my courses took excellent, but terse notes. In the notes from one of the lectures delivered in March, 1914, the following phrase, an extremely concise statement of the orientation theory, appears in connection with a discussion of interfacial energy and the spreading of oleic acid on water:

> COOH of acid down because both acid and water associated and polar.

Thus it was considered that when an organic substance spreads on water, a polar liquid, the active or polar group is oriented toward the water, and the inactive or hydrocarbon group toward the vapor phase.

These surface energy relations find their most important application in the field of colloids, particularly with reference to the structure and action of living organisms, but they are also of interest in connection with soaps and cleansing, paints and varnishes, milk and butter, food and medicinal substances.

In order to understand the action of surfaces, it appeared essential to learn as much as possible about the electrical structure of molecules and of atoms, so, in 1913, I began to study more intensively the current theories of atomic structure. In 1904, Nagaoka had suggested that an atom consists of a central sun or nucleus and a system of negative electrons as satellites. This theory was amplified by Rutherford, who showed that the positively charged atom nucleus appears to be extremely minute in comparison with the space occupied by the atom. For many years the phenomena of radioactivity had been extremely fascinating to me, and this was undoubtedly what caused my attention to be directed more specially to the nucleus, which determines the stability and even the existence of the atom as a whole.

The committee in charge of the arrangements for the Gibbs lectures has asked that a detailed discussion be presented concerning one of the general topics to which I have given particular attention, and I have chosen the subject "Atom Building," or modern alchemy, as the second topic in this series of two lectures.

II. ATOM BUILDING

1. Ancient and Modern Alchemy

One of the earliest experiences of a human being is that of becoming acquainted with the objects and the substances which make up his environment. Much later he may or may not learn that some substances are simpler than others, and that these, ninety-two in all, constitute the alphabet of nature from which all material things are made.

That some of these simple substances, or chemical elements, are more abundant than others is commonly taken as a matter of course, even although the relative abundance of the elements determines not only the environment but also the nature of life itself: in fact even its existence or non-existence. Thus arsenic and iodine are rare, and oxygen and iron abundant. How different life would be if the reverse were true!

The abundance of an element is determined by the stability of its atoms and the processes by which they are formed, and those by means of which one element (or more correctly atomic species) is converted into another.

For several thousand years the development of chemistry has been profoundly influenced by the idea that one element may be transmuted into another by an artificial process, although during the nineteenth century the alchemistic idea became discredited for a considerable period. It is natural that the greatest effort should have been placed upon attempts to change other elements, especially other metals, into gold, since this was the most beautiful, permanent and the most valuable of all known metals. Thus, one expression of the alchemistic idea is as follows:

> Since . . . the substance of the metals is *one*, and common to all, and since this substance is (either at once, or after laying aside in course of time the foreign and evil sulphur of the baser metals by a process of gradual

digestion) changed by the virtue of its own indwelling sulphur into *gold*, which is the goal of all the metals, and the true intention of nature—we are obliged to admit, and freely confess that in the mineral kingdom, as well as in the vegetable and animal kingdoms, nature seeks and demands a gradual attainment of perfection, and a gradual approximation to the highest standard of purity and excellence.[2]

The idea that all elements are formed from one primordial constituent is shown by this and other writings to be a very early one.

While ancient alchemy was so intimately associated and intermingled with mysticism that the two can not be disentangled, this is not true of the alchemy of the twentieth century. Nevertheless, one feature of the early work persists in almost all that is done at the present time: erroneous or incomplete observations, commonly with impure substances, are cited to show the change of one element or metal into another. In early alchemy, iron, in a stream which came from a deposit of copper ore, seemingly became converted into copper; impure mercury, when distilled, left a residue of gold. Is it at all strange that the alchemists adduced such phenomena as evidence for the transmutation of one element into another?

Within the last few years the belief in transmutation has become so intense that even able scientists, on finding gold in impure mercury, have believed it formed by an electronic change in the mercury itself, although the obvious explanation is that the gold was originally present and was sufficiently concentrated by the experimental process employed to be more easily detected in the final product. Not only gold, but also lead, helium and copper have been thought to be formed from certain metals by comparatively mild processes; that is, by those in which the intensity of the energy employed was very low. In no case is there a sufficient verification of the success of any attempt to change one chemical element into another by any artificial process whatsoever.

There are certain factors which are undoubtedly related to this failure of the modern alchemists: (1) It is probable that atomic transmutations are usually slow when small intensities of energy are applied, and are often slow with large intensities. (2) Many atomic transmutations do not take place with any measurable speed unless the intensity of the energy is extremely high.

Thus a part of the lack of success of artificial means is undoubtedly due to difficulty of obtaining and applying energy of the requisite high intensity, and may be due in some cases to the difficulty of detecting the minute amounts of the products of the transformation which are formed.

[2] "The Golden Tract Concerning the Stone of the Philosophers" (see "The Hermetic Museum," vol. 1, p. 19).

It is often assumed that the total energy applied, for example, several hundred thousand volts from an induction coil, is utilized in the atomic transmutation. However, if such a discharge is passed through air or oil to a mercury surface the total energy is distributed between so many atoms that the energy per atom is small.

While it seems certain that if an electron could be attached to the nucleus of an atom of mercury, the atom would become one of gold, and while it seems, from electrostatic considerations, that the positive nucleus of a gold atom should attract an electron, at distances not too large or too small, it is also probable that if the electron is to sufficiently penetrate the atom of mercury, a certain threshold energy must be exceeded—at least, that this must be true to insure a sufficient probability of penetration to give a yield large enough to be detected by chemical means. From this point of view, the bombardment of the mercury by electrons should occur in an X-ray tube, or more efficiently by means of a Coolidge electron tube. However, by the application of an X-ray tube with a mercury anticathode it was found that 145,000 volts per electron, or a velocity for the electron of 12,000 miles per second, is not a sufficient amount of energy to give in pure mercury a detectable amount of gold, even with the use of an extremely delicate test, so delicate that it was capable of detecting one part of gold in one hundred billion parts of mercury.[3]

Notwithstanding the failure thus far of all artificial means, it has been possible, by photographing the tracks of atoms in gases, to observe in the laboratory a *natural* process by means of which heavier atoms are produced by lighter ones. Thus the natural synthesis of atoms has been demonstrated. A description of the method used is given in section (9).

2. The Natural Disintegration of Atoms

The remarkable discovery of Becquerel (1896) and others that various "rays" are emitted by certain elements of high atomic weight gave a remarkable climax to nineteenth century chemistry. During this century the prevailing idea seemed to be that atoms are indivisible, and extremely hard and indestructible. That matter is built up of indestructible particles was suggested very early, and the idea was expressed in an interesting way by Newton:

> It seems probable to me, that God in the beginning formed matter in solid, massy hard, impenetrable, movable particles, of such sizes and figures, and with such other properties, and in such proportion to space, as most conduced to the end for which He formed them; and that these primitive particles, being solids, are incomparably

[3] This test was developed by Haber for the purpose of determining the gold content of the water of the Rhine.

harder than any porous body, compounded of them, even so very hard as never to wear or break in pieces; no ordinary power being able to divide what God Himself made one in the first creation.

In contrast, the point of view at present is that we are very far as yet from the minuteness of scale which might permit the indivisibility of particles, and that even the conception of indivisibility at even the most minute magnitudes is very difficult of comprehension.

In radioactive processes the atoms emit gamma rays, which are extremely penetrating, but otherwise like X-rays. They also shoot out very fast particles, charged with either negative or positive electricity. The negative particles have been found to be negative electrons, with a mass when at rest about $\frac{1}{1,845}$ that of a hydrogen atom. The positive particles are doubly charged helium atoms (alpha particles). The electrons are found to possess varying speeds, with a maximum of the order of about 180,000 miles per second. The alpha particles have initial speeds as high as 20,000, or even more, miles per second. The initial speed is not continuously variable as for electrons, but is constant or nearly constant for any specific disintegration.

3. The Composition of Atoms

If the evidence of the radioactive disintegration of the heavy atoms is taken literally, the evident hypothesis is that atoms are composed of negative electrons and doubly charged helium atoms (He^{++} or α). However, the latter can not be the primary constituent of all matter, since it is heavier than the hydrogen atom. The lightest known positive particle is the hydrogen ion in a gas, and this is called the positive electron or *proton.*

According to the Nagaoka-Rutherford theory, an atom consists of a minute positive nucleus, which contains nearly all the mass of the atom (usually all but about $\frac{1}{3,700}$), surrounded by a diffuse system of negative electrons. Experiments made by shooting alpha particles through gold foil and through nitrogen indicate that the diameter of the nucleus is only about $\frac{1}{10,000}$ that usually ascribed to the atom. If this is actually the case, the nucleus has only one millionth of a millionth the volume of the atom, and a cubic centimeter of tightly packed nuclei would have a mass of about a million tons. This density of one thousand billion is extremely high even when compared with the density of 50,000 attributed by certain astronomers to the companion of Sirius, but the repulsion between such positively charged nuclei is presumably so high that no such density can be attained.

All ordinary matter which we know is very nearly electrically neutral, and is probably extremely close to exact neutrality. Since the proton and the electron have practically identical charges in magnitude, though opposite in sign, this indicates that the number of electrons in any atom is equal to the number of protons. Thus the oxygen atom is supposed to consist of 16 protons and 16 electrons. If the principles of electrostatics alone are considered, it is to be expected that protons attract electrons, but protons repel protons, and electrons repel electrons.

In the formation of an oxygen atom, and of most other atoms also, all the protons unite with exactly half the electrons to form an extremely stable group, the nucleus. The remaining half of the electrons are united in this by comparatively weak forces. In a much smaller number of atoms, the number of nuclear electrons is slightly in excess of half the number in the atom as a whole.

4. The Problem of Atom Building

The atom may be broken up with great ease into one or more electrons and a positive residue or core, but the central nucleus has an altogether different, higher order of stability. If the nucleus of an atom can be formed by any means whatever, it will pick up electrons from the surroundings and thus become converted into a complete atom. The problem of atom building is thus reduced to the building of atom nuclei.

It is self-evident that the nuclei of the heavier atoms are built either in one step or in several steps. While light atom nuclei, such as the alpha particle, may be formed in one step from protons and electrons, the probability that this may be true for heavy atoms, such as uranium, is exceedingly small.

Thus the nucleus of uranium I contains 238 protons and 146 electrons, and all these must meet in a volume, which, according to experiments on scattering, is of the order of 10^{-36} cc, or about one trillionth the volume of the atom. That all these should meet in such a small volume in one instant (or in say 10^{-12} seconds) would seem to be an event of almost infinitesimal rarity.

5. The Periodic System of the Elements

In the decade between 1860 and 1870, a classification of the elements was made in such a way as to later throw great light on what is now termed technically the structure of the atom. Newlands found that when arranged in order of their atomic weights the elements fall into octaves or periods of eight with respect to the variation of their chemical and

physical properties. Mendeleeff developed this idea into what is called the periodic system of the elements. He arranged the elements according to an element number, misnamed the atomic number, which was later found to be identical, when all the elements are included, with the magnitude (in electron units) of the positive charge on the nuclei of the atoms of the element. The length of the periods of this system are 2, 8, 8, 18, 18 and 32 elements, or 2×1^2, 2×2^2, 2×2^2, 2×3^2, 2×3^2 and 2×4^2, though in the periods of 18 and 32 certain secondary periods of 8 are to be found.

It is now believed that this periodic variation in chemical and physical properties gives an index to the structure of the system of electrons outside the nucleus, or of the non-nuclear part of the atom. Thus lithium, sodium and potassium are much alike in physical and chemical properties, although sodium contains 8 more non-nuclear electrons than lithium, and potassium 8 more than sodium. This likeness of properties is supposed to be due to the occurrence of one loosely attached (or outer?) electron in each of these atoms. If seven more non-nuclear electrons are present than in lithium, the seven go into the same set as the one already present, and the element is neon. The atoms of neon are inactive and have little attraction for themselves or other atoms. Thus sets of light electrons are supposed to form a *complete* set of firmly bound electrons.

6. The Periodic System of the Atomic Species (The New Periodic System)

Since the loosely bound (non-nuclear) electrons give definite periods of variation to the chemical and physical properties of the elements, it seems natural to suppose that the tightly bound (nuclear) electrons and protons may also exhibit some sort of periodic variations. The difficulty arises that the nuclei of atoms do not directly affect the ordinary physical or chemical properties of the elements.

In 1914, an attempt was made to find some characteristic of atomic nuclei already observed which would serve as a basis of a new classification. The characteristic chosen was that of atomic stability. Since the stability of the atom is that of its nucleus, this involved a study of nuclear stability.

The only atoms whose stabilities were known at that time were those of the radioactive or heavy elements. Each of these elements consists of several atomic species; that is, of several types of atoms of different stability. Thus the ten radioactive elements were known to consist of more than forty atomic species. If several species belong to one element, if the nuclei of their atoms have the same positive charge, they are called isotopes.[4]

[4] The term isotope is often used in an entirely improper sense. Isotope in no case signifies the species of more than one element. Thus, about two hundred atomic species are known, but not more than eleven isotopes.

It was noticed that if one negative electron is emitted from the nucleus, a second follows, and that the presence of a single or odd electron is accompanied by nuclear instability.

The radioactive elements alone, however, did not give enough data for the development of the desired relations. Since the stabilities of the ordinary elements were totally unknown at that time, it was necessary to establish a hypothesis as the basis of further work.

It was therefore assumed that: ***The abundance of an atomic species[5] is related to the stability of its atoms, and in general the most abundant species represent the most stable atoms.***

It was not assumed that the stability of an atom is the only factor which influences its abundance. Thus, the rate at which any species of atoms is formed may depend on still other factors than stability. For example, the most abundant species known is oxygen, while carbon is a comparatively rare element. Now if an atom of carbon of mass 12 is converted into an atom of oxygen of mass 16 by the addition of a helium nucleus (α-particle) of mass 4, then the amount of carbon in existence depends not only upon the stability of the carbon nucleus but also upon the extent to which it has been converted into oxygen.

However, notwithstanding this difficulty, the use of the above principle has been justified by the discoveries of the past decade.

The variation of the stability of atoms with the composition of their nuclei is expressed by a number of relations listed below.

(1) ***First periodic relation: high stability and abundance for species of even electronic number.*** The most important and general of the periodic relations which concern nuclear stability relates to the number of negative electrons in the nucleus (electronic number).

In general atoms of even electronic number are extremely more abundant and stable than those of odd number, and the number of species of atoms is also much larger.[6]

The remarkable emphasis which nature has put upon this relation is only feebly expressed by Fig. 1, which gives the abundance of the atomic species on earth. The contrast in abundance between even and odd electronic numbers is very great. Thus, if be-

[5] The term *atomic species* was not used in the first papers but was devised later to express the meaning of the above principle. According to earlier use the term element might refer to a single isotope of a radioactive element or to the whole chemical element.

[6] *J. Am. Chem. Soc.*, 39: 858 (1917), Table II; *Physical Review*, 15: 73–94 (1920); *J. Am. Chem. Soc.*, 42: 1956–97 (1920).

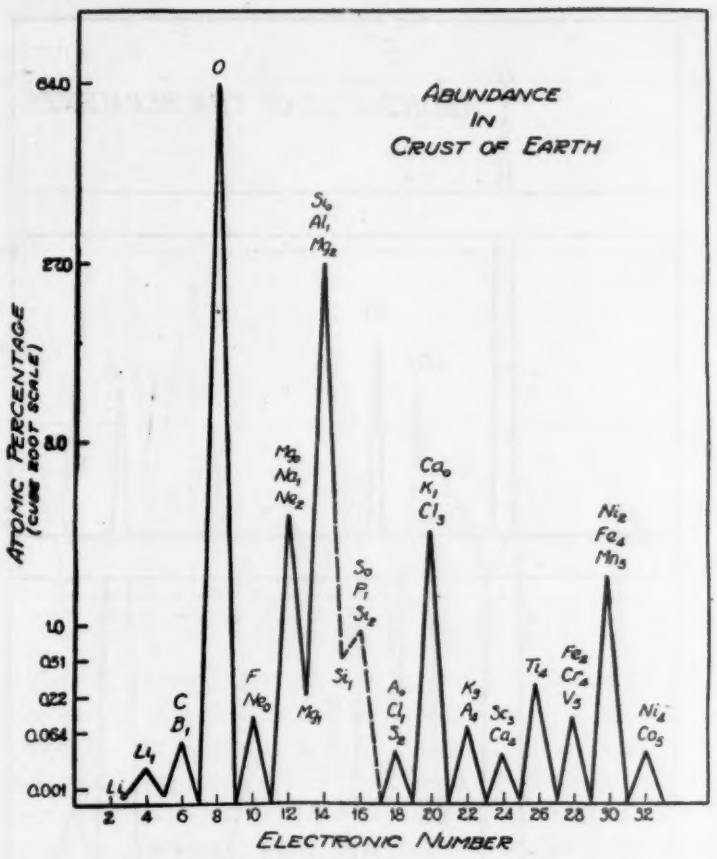


FIG. 1

tween numbers 0 and 12 the highest abundance for the species of any odd number is represented by a height of one eighth inch, as it is in the figure, then on the same scale the peaks for species of even number would rise as high as 700 feet. Furthermore, the species of odd electronic number are so rare that, with only four exceptions, they have not even been discovered. Also, for each even number the species are more abundant than for either of the two adjacent odd numbers. Fig. 2 shows that the general relations for the material of the meteorites are exactly the same.

Not only do the species for each even electronic number exhibit a higher abundance, but in addition the number of species is relatively large (Fig. 3). The fact shown by this figure is extremely remarkable in that the average number of known species is twenty-three times higher for an even than for an odd electronic number.

The above relations may be expressed more concisely by the statement: *The number of electrons in the nucleus is even for almost all atoms and for almost all species of atoms.*

Among the radioactive elements all the most stable species are those of even electronic number, for example, the half-life of uranium is five billion years; for uranium 2, it is two billion years; of ionium, two hundred thousand years, and of radium, 1,730 years. In contrast the longest half-life for a species of odd electronic number is only five days. Also, among the ordinary elements, the most abundant isotope of every element thus far investigated has an even electronic number, with only two exceptions: nitrogen and xenon.

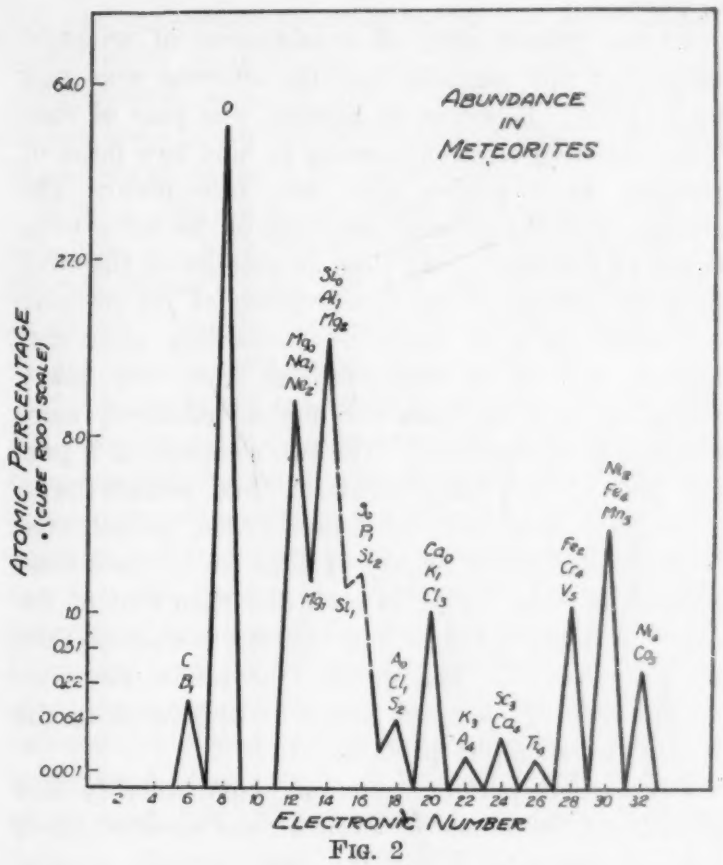


FIG. 2

In a paper which considered the nucleus of the atom to be built up from groups of protons and electrons, one of the tables[7] lists in elements 2 to 27

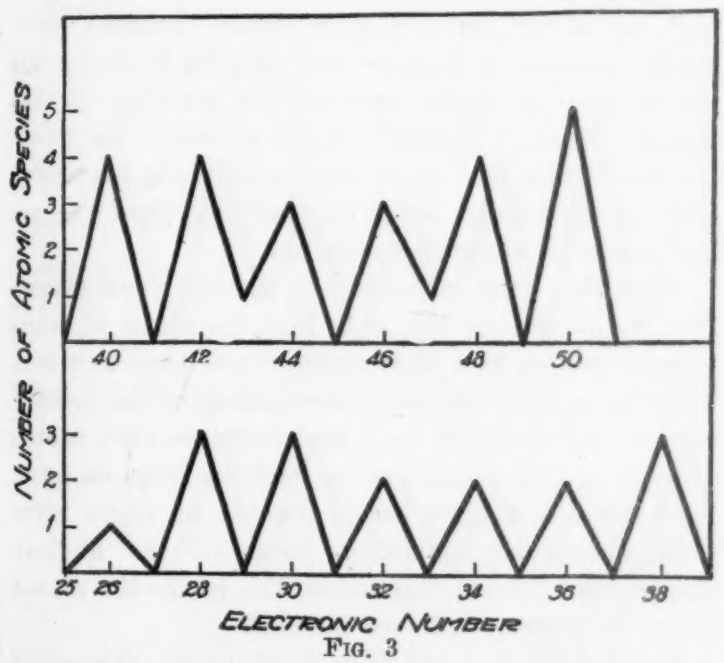


FIG. 3

a total number of 202 groups, each of which contains a pair of electrons, and in addition eight extra pairs of electrons, while in the same set of elements there are only two odd or single electrons.

[7] Table II, "The Evolution and Stability of Complex Atoms," *J. Am. Chem. Soc.*, 1917.

Whether or not the groups specified in this table exist as such, it seems probable that: The negative electrons in the nuclei of atoms are largely associated in pairs.

At the present state of development of quantum mechanics this suggests that the electron spin may be involved. However, in general, one pair of electrons (binding electrons) seems to bind two pairs of protons, so a proton spin may also occur. The analogy with the pairs of electrons of the outer atom is not of necessity at all close on account of the complication introduced by the presence of the proton.[8]

Certain pairs of electrons (cementing electrons) may be emitted as beta particles from very heavy atoms, or serve to make the nucleus relatively more negative in lighter ones. The two electrons of a pair are not ejected simultaneously, but consecutively. That there is a relation between them is indicated by the fact that the energy of emission of the second electron is much higher in each case than that of the first. In some instances, one electron is emitted, then an alpha particle, and quickly the second electron; or the pair of electrons seems to be related to the holding of an alpha particle.

(2) *Second periodic relation: high stability and abundance for atoms of even atomic number (even nuclear charge).* While the first periodic relation was discovered by mapping the electronic and protonic composition of atom nuclei, the second was predicted from a theoretical basis. This theory was that the nuclei of atoms other than hydrogen are built up almost entirely from alpha (helium) particles; but that, if they are not actually built up by the addition of alpha particles, the stability of the nucleus becomes relatively high whenever its composition is that of a whole number of alpha particles, or a whole number of alpha particles plus one or more pairs of cementing electrons.

From this point of view, the stability, and therefore the abundance, should be high for atoms of even atomic number, that is, for elements of even number. Thus the positive charge on the nucleus of the helium atom (alpha particle) is 2, and therefore only atoms of even nuclear charge can be built up from, or have the composition of, a whole number of alpha particles. Since the numerical value of the nuclear charge gives the atomic number, this means the atoms belong to elements of even number.

Fig. 4 shows that in the meteorites *each element of even atomic number is very much more abundant*

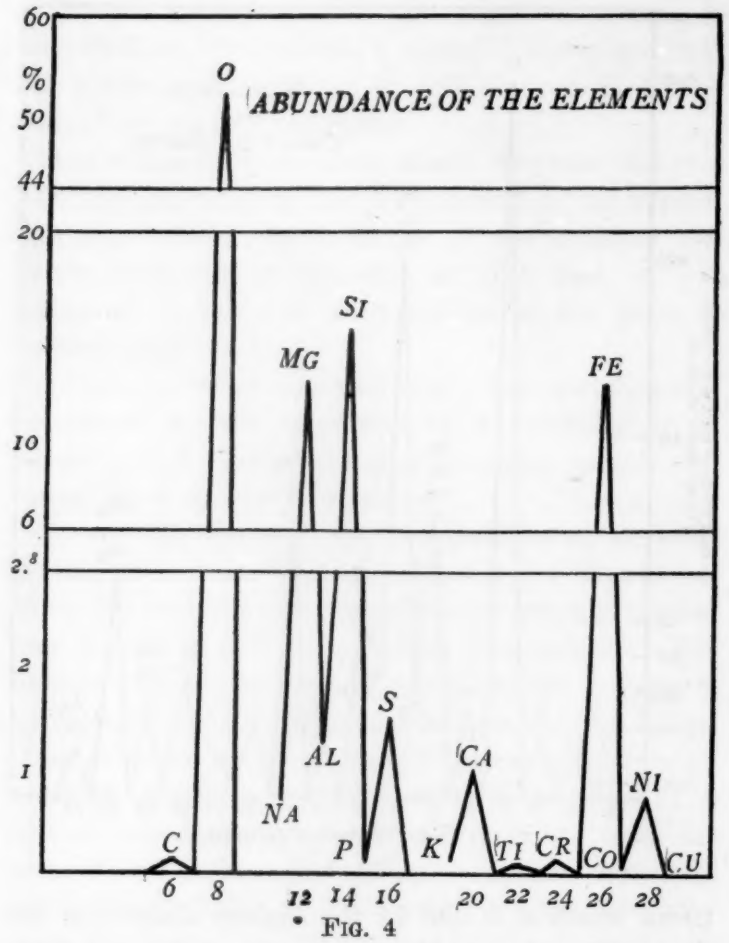


FIG. 4

than the adjacent elements of odd number. Furthermore, every one of the five most abundant elements, oxygen, silicon, iron, magnesium and sulphur, has an even number. Of the material of the meteorites 98.8 per cent. consists of even, and only 1.2 per cent. of odd numbered elements.

In the meteorites there are 70 atoms of even to 1 of odd nuclear charge, while in the earth's crust the ratio is 9 to 1 (hydrogen excluded, since it is considered as the fundamental element). The crust of the earth does not properly represent the composition of the earth as a whole, since there has been much segregation of material. In order, therefore, to determine to what extent in the earth the elements of even number are more abundant, the data used should refer to elements such as the rare earths whose relative abundance has not been greatly affected by processes of segregation. Twelve years ago the writer showed that each rare earth of even number is much more abundant than the two adjacent elements of odd number. Later experimental work by Goldschmidt and Thomassen, as represented by Fig. 5, gives further evidence which exhibits the great contrast between even and odd.

Additional evidence for the idea that elements of even number have the more stable atoms is shown by the fact that they are not so easily disintegrated by bombardment with alpha particles (Rutherford) and by the fact that for very light atoms the packing effect (loss of mass) involved in their formation from

[8] Thus the statement which sometimes appears in papers on the new quantum mechanics that the "pairing of the electrons in the nucleus is the result of the Pauli principle" is peculiarly enigmatic, since the Pauli principle was deduced from systems in which no protons are present, and also long after the pairing in the nucleus was postulated.

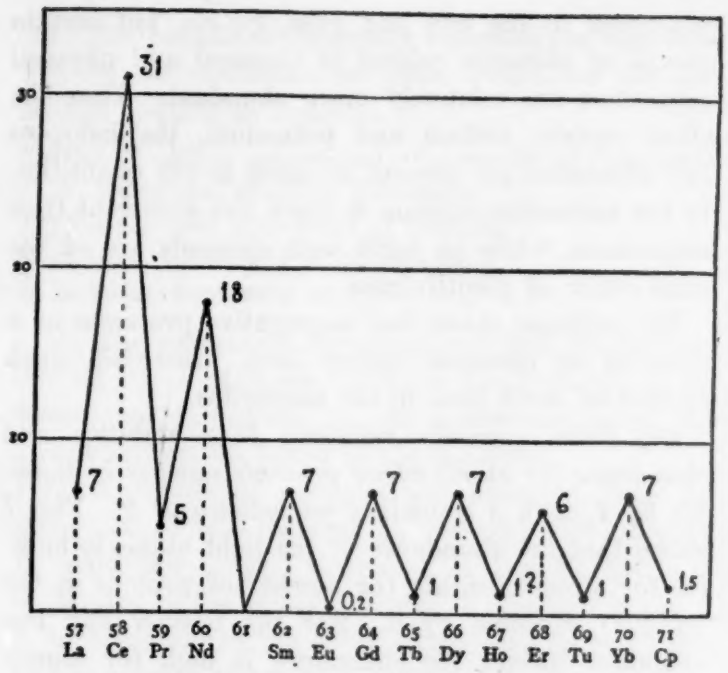


FIG. 5. Periodicity of two in the abundance of the rare earths as a function of the atomic number, as determined by Goldschmidt and Thomassen. The height of each point represents the abundance of the rare earth element in minerals on the surface of the earth. Obviously each element of even number (number given below) is very much more abundant than either adjacent element of odd number. This accords exactly with the predictions of the hydrogen-helium theory of atom building developed eight years before the work represented above was done by Goldschmidt and Thomassen.

hydrogen is much less than for elements of odd number (Costa and Aston).

If the atoms of the elements of even number are more stable in general than those of odd number, then there should be not only more atoms but also more kinds of atoms of even number. Fig. 6 shows that the number of species per element (isotopes) is much larger for even than for odd atomic numbers. The mean number of isotopes per element as shown in the figure is 5.4 for even and 1.6 for odd, while for the radioactive elements values are 4.5 and 1.8, respectively.

In general, also, the most stable isotope for each radioactive element has an enormously longer life than the adjacent elements of odd number.

It is of interest in connection with this relation to note that the only two undiscovered elements are in the radioactive region, and that both have odd atomic numbers. Possibly these are so unstable that they do not exist on earth in detectable quantities.

(3) *Primary and secondary factors which determine the abundance of the elements.* It is evident from the preceding discussion that there is a direct relation between the abundance of the elements and the atomic number, and that there is no very marked relation to the periodic system of Mendeleeff. This indicates that the abundance of the elements is determined in a primary sense by the stability relations of the complex atoms themselves, and also by the stability of any electron-proton groups, such as the alpha particle, from which they may be built. However, it is obvious, *even if in the formation of the elements there*

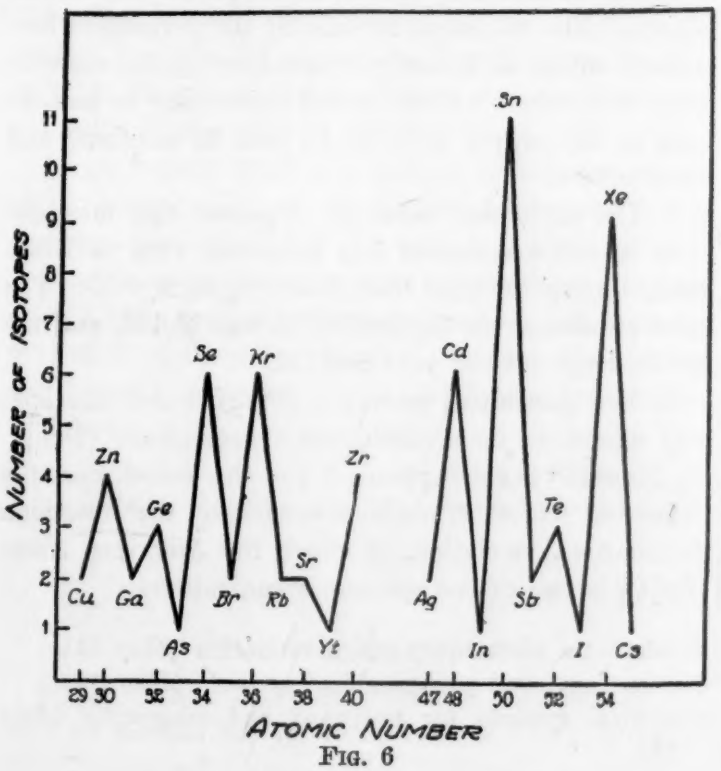


FIG. 6

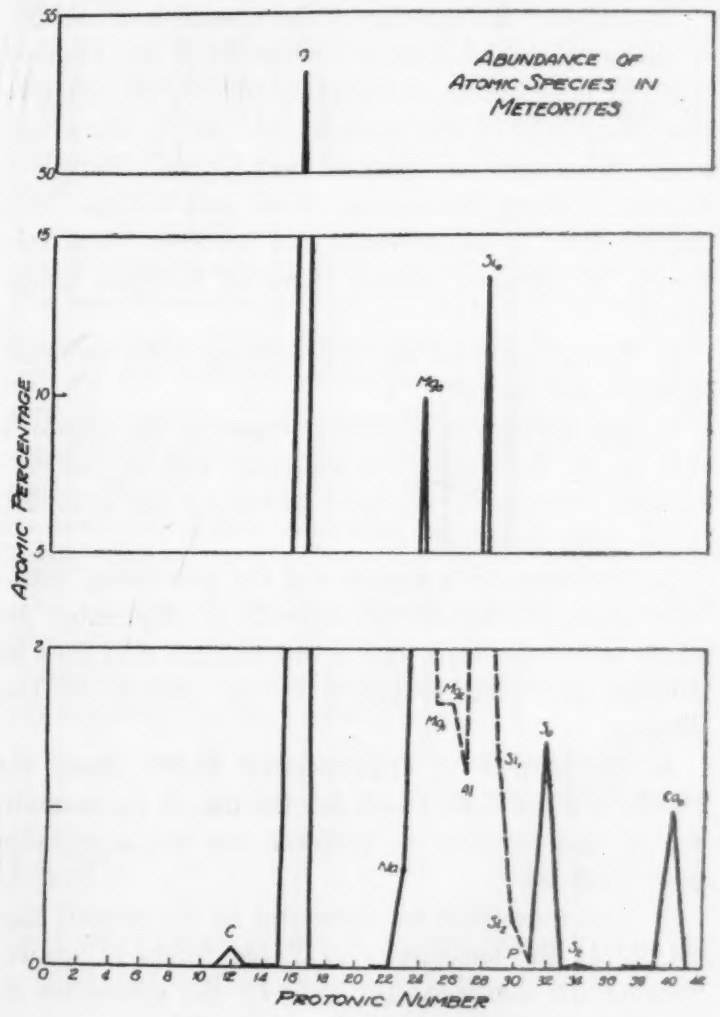


FIG. 7

is no relationship to the ordinary periodic system, that in all the differentiative processes which occur after the original formation, the chemical and physical properties would play their part, so that if any special material is taken for consideration, relationships to that system would appear more and more as the process of differentiation takes place.

The fact that in the meteorites the elements of even atomic number are in all cases more abundant than the adjacent elements of odd number seems to indicate that in such bodies the process of differentiation has not proceeded to such an extent as to cause the chemical and physical properties to have an influence sufficient to obscure in any marked degree the most general of the abundance relations due to nuclear stability, but it does not show that there has been an entire absence of differentiation. The composition of the earth's surface, as compared with that of the meteorites, shows a less rigid, but very marked adherence to the odd and even system, but certain groups of elements related in chemical and physical properties are relatively more abundant. Thus the alkali metals, sodium and potassium, the halogens and aluminum are present in much larger quantities. In the meteorites calcium is much less abundant than magnesium, while on earth both elements are of the same order of plentifulness.

The evidence shows that segregative processes of a physical or chemical nature have proceeded much farther on earth than in the meteorites.

(4) *Third periodic relation: high stability and abundance for atoms whose protonic number is divisible by 4, with a secondary periodicity of 2.* Fig. 7 shows that the abundance of the light atoms is highest for atomic weights (or number of protons in the nucleus) divisible by 4. For the heavier and less abundant species the abundance is high for atomic weights divisible by 2.

(*To be continued*)

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE REGULAR FALL MEETING OF THE EXECUTIVE COMMITTEE

THE regular fall meeting of the executive committee of the American Association occurred at the Cosmos Club, in Washington, on Sunday, October 20, one session being held in the forenoon and one in the afternoon. The members present were Cattell, Compton, Curtiss, Kellogg, Livingston, Ward and Wilson. Absentees were Lillie, Millikan and Moulton. The following paragraphs present items of business transacted:

1. The minutes of the last meeting were reported as approved by mail.

2. The permanent secretary presented the auditor's reports on the treasurer's statement and on the permanent secretary's financial statement for 1927–28, which were accepted.

3. The treasurer's report and the permanent secretary's financial report for 1928–29, of September 30, 1929, were presented, and it was ordered that they be audited and then presented to the council at Des Moines.

4. The committee appropriated $1,000 from the treasurer's available funds for the use of the committee of one hundred on research for the association year 1929–30.

5. The committee recommended to the council that $3,000 of the treasurer's available funds be appropriated for allotment for 1930 by the committee on grants for research.

6. The permanent secretary reported the publication, on October 15, of the volume of Summarized Proceedings for 1925–29 and the report was accepted. The edition is of 4,250 copies, of which 3,877 have been disposed of; 3,637 copies were sold, 125 copies were sent free to section and society secretaries and secretaries of special committees of the association and 115 copies were sent free to foreign organizations and institutions. No free copies are to be sent to organizations and institutions in the United States and Canada unless by special action of the association council. The volume is for sale by the permanent secretary's office, at $3 each to members of the association, $4 to others. Cloth-bound copies may be had, as long as the supply lasts, at $4 each to members and $5 to others.

7. The permanent secretary reported that membership in the association has increased very satisfactorily during the year that closed September 30. The total enrolment on September 30 was 18,462, and the net increase for the year is 2,134.

8. The permanent secretary reported that the special committee on symbols and abbreviations (Dr. A. E. Kennelly) had approved for the association the following sets of symbols presented by the American Standards Association, of which the American Association is one of the sponsor organizations:

Symbols for photometry and illumination (May 13).
Navigational and topographical symbols (May 15).
Graphical symbols for telephony and telegraphy (July 26).
Symbols for hydraulics (July 26).

9. The permanent secretary reported the organization of the committee on prize award for the Des Moines meeting as follows:

Charles E. Allen (*chairman*), University of Wisconsin.
P. W. Bridgman, Harvard University.
Fay-Cooper Cole, University of Chicago.
S. C. Lind, University of Minnesota.
H. L. Rietz, University of Iowa.

10. The permanent secretary reported the nomination of Dr. J. McKeen Cattell to the Institute of International Education, as the representative of the association on the board of the institute.

11. A report of progress was accepted from the committee of one hundred on research (Dr. Rodney H. True, *secretary*). A session at Des Moines is to be devoted to the economic status of research workers, in continuation of the series of sessions on this topic held at recent annual meetings.

12. A report on the Press Service was accepted, from Mr. Austin H. Clark, director of that service. Arrangements for reaching the public in connection with the Des Moines meeting are being worked out, not only through the usual newspaper channels but also by means of many non-technical lectures and radio talks.

13. A progress report was accepted from the special committee on source books in the history of the sciences (Dr. Gregory D. Walcott, *chairman*). The "Source Book in Astronomy" has been published and that for mathematics will soon appear. Others are in preparation.

14. A progress report was accepted from the special committee on book lists for libraries (Joseph L. Wheeler, *chairman*). The committee is engaged in compiling attractively printed lists of books in the several branches of science, the titles being selected as suitable for use by those who are not scientific workers but are interested in science.

15. A report from the special committee on calendar reform (Dr. A. E. Kennelly, *chairman*) was accepted and referred to the council at Des Moines.

16. The committee elected to fellowship in the association 145 members, whose nominations had been approved in the regular way by the respective section secretaries. These are distributed among the sections as follows:

Section B, 1	Section F, 26
Section C, 10	Section G, 72
Section H, 1	Section M, 17
Section L, 12	Section N, 6

17. On its application, the Roentgen Ray Society was officially affiliated with the American Association. The society has 409 members, of whom 27 are members of the association, 10 of these being fellows.

18. Resolutions from the Pacific Division and the Southwestern Division, on importations into the United States for use in educational and research institutions, were considered by the executive committee and referred to the council at Des Moines.

19. A letter from Dr. A. A. Noyes was read, in which he asked to be allowed to decline his recent election to the executive committee. This resignation was accepted with regret.

20. Dr. Joel H. Hildebrand was elected to membership in the executive committee, his term of office to expire at the end of the annual meeting for 1931–32.

21. The proposal that the association might arrange to hold summer meetings was made a special order of business for the executive committee at Des Moines.

22. The permanent secretary presented a summary of replies to a circular letter sent to section chairmen and secretaries, concerning eligibility to fellowship in the association and means for securing nominations for fellowship. The problem of fellowship was made a special order of business for the executive committee at Des Moines.

23. The permanent secretary reported on plans for the Des Moines meeting, which were discussed at length.

24. The executive committee voted to hold its first Des Moines session at 10 on Friday, December 27. It was voted that the first council session at Des Moines is to be held at 2 on Friday and that the second session of the executive committee will follow the first council session. Other Des Moines sessions of the council and executive committee are to occur on Saturday, Monday, Tuesday and Wednesday at 9 and 10, respectively, unless otherwise decided at one of the earlier sessions.

25. It was voted that the election of association president and other officers be made a special order of business for the council at Des Moines, at the Tuesday morning session, December 31.

BURTON E. LIVINGSTON,
Permanent Secretary

OBITUARY

EDWIN E. SLOSSON

WHEN Edwin E. Slosson died on October 15, the field of science lost an individual so richly endowed with unique gifts as to make it difficult to carry on the type of work in which he was preeminent. Dr. Slosson was born in Albany, Kansas, in 1865, of old pioneer colonial stock, and his ancestry could be traced to three of the Mayflower pilgrims. After

graduating from the University of Kansas, where he was elected to both Phi Beta Kappa and Sigma Xi, he went in 1891 to the University of Wyoming to take charge of the Department of Chemistry and to conduct chemical research for the Wyoming Agricultural Experiment Station. He continued his studies and in 1902 was awarded his Ph.D. from the University of Chicago. In 1903 he became literary editor of the *Independent,* which position he held until 1921, when he became director of Science Service, then newly organized as an agency to disseminate authentic news regarding advances in the world of natural sciences.

Dr. Slosson early exhibited the ability to present clearly the facts, theories and progressive work of science in language which the non-technical reader could understand. In the early days he wrote numerous essays on scientific subjects and later became widely known as the author of such successful works as "Creative Chemistry," which doubtless has enjoyed the greatest circulation of any book of its kind, "Chats on Science," "Snapshots of Science," "Keeping up with Science," "Plots and Personalities," "Easy Lessons in Einstein" and "Sermons of a Chemist." Thousands have heard his lectures, always successful because he possessed the ability to mix a dry humor with facts which were thereby relieved of their dryness. His books displayed much of the same wit and everywhere there is evident his insatiable appetite for knowledge, his perpetual desire to know, which coupled with an excellent memory gave him a storehouse of interesting facts, from which he drew at will and upon a moment's notice those which seemed best suited for a particular occasion.

The success which has been that of Science Service has been due in large measure to the leadership which Dr. Slosson gave the enterprise. In this work he wrote and spoke extensively and yet had time to train a group which carried on much of the work of the service and which must now continue to develop that enterprise into a living memorial not only to the man who provided the fund but to its first director. To replace him, however, upon the numerous committees of which he was a member and on the advisory editorial boards where his counsel was so valuable will indeed be well-nigh impossible. The impetus he gave to the humanizing of science will not be lost and the written record he has left of his work will serve as a guiding torch for those who take up the important burden of having the public understand what the progress of science means to it.

H. E. HOWE

RECENT DEATHS

JOHN W. LIEB, senior vice-president of the New York Edison Company, a past president of the American Institute of Electrical Engineers, died on November 1, in his sixty-eighth year. Mr. Lieb was one of the early associates of Mr. Thomas A. Edison.

FRANCIS A. J. FITZGERALD, head of the Fitzgerald Laboratories, Niagara Falls, a former president of the American Electro-Chemical Society, died on October 26 at the age of fifty-nine years.

RALPH WAINWRIGHT POPE, honorary secretary of the American Institute of Electrical Engineers, died on November 1 at the age of eighty-five years.

PROFESSOR LEONARD S. AUSTIN, metallurgical engineer and chemist, at one time professor in the Michigan College of Mines, died at Los Angeles on October 29. He was eighty-three years old.

HENRY DAGGETT HOOKER, for the past ten years Associate Professor of Horticulture at the University of Missouri, died on October 26, at the age of thirty-seven years.

DR. JAN METZELAAR, member of the staff of the University of Michigan Museum and state custodian of fishes, was drowned on October 4, when the boat in which he was fishing capsized. Dr. Metzelaar was thirty-seven years old.

THE death is announced of Dr. Ernest Edward Glynn, formerly Holt professor of pathology at the University of Liverpool.

DR. J. A. LEACH, the Australian ornithologist, has died at the age of fifty-nine years. Dr. Leach was one of the nine Colonial members of the British Ornithological Union and a member of the American Ornithological Union.

DR. LOUIS CAPITAN, member of the Académie de Médecine de Paris, Loubat professor of American archeology in the Collège de France and professor of prehistory in the Ecole d'Anthropologie de Paris, died in Paris on September 1.

SCIENTIFIC EVENTS

THE FLORIDA ANTHROPOID LABORATORY OF YALE UNIVERSITY

THE announcement is made by President James R. Angell that Yale University has acquired nearly 200 acres of land near Orange Park, Florida, on which it will establish a laboratory station for the breeding and scientific study of the anthropoid apes. The establishment of this station and its maintenance for the next ten years has been made possible by the gift of $500,000 from the Rockefeller Foundation.

The general plans for the organization of the station and the site for its establishment have been approved by a committee of distinguished scientific men, including in addition to representatives of Yale, Pro-

fessor Edwin G. Conklin, of Princeton University; Dr. Milton J. Greenman, of the Wistar Institute, Philadelphia; Professor Theobald Smith, of the Rockefeller Institute; Dr. Clark Wissler, of the American Museum of Natural History, New York; Dr. H. Gideon Wells, of the University of Chicago, and Dr. John C. Merriam, president of the Carnegie Institution of Washington. This group will also serve as an advisory board for the general supervision of the program of the station, which it is planned to conduct in such a manner as to make it helpful to all university and scientific agencies working in the field of its interests.

A special laboratory will be built on the Florida site for the intensive study of one or more species of the anthropoids, which include the chimpanzee, the gorilla, the orang-utan and the gibbon. According to the announcement, detailed observation will be made of the habits, social relations, life history and psychobiological development of these animals.

The station will be under the general supervision of Professor Robert M. Yerkes, who has for many years been seeking the establishment of such a station, and who began the work in comparative psychobiology at Yale University five years ago. The academic center for the activity will remain in New Haven, where it is hoped that enlarged laboratories and equipment may be obtained in proximity to the Institute of Human Relations, of which the psychobiology unit will be a part. Senior members of the staff of the unit will alternate between the Florida station and the New Haven laboratories, spending some months in each place. It is expected that the staff in Florida will consist of a director, a research associate and a few research students.

Observational field camps are planned in Africa and Malaysia. Here the anthropoids and other primates will be studied in their natural surroundings. Such work is now being conducted by Dr. H. C. Bingham, who is studying the mountain gorilla in the Belgian Congo in the heart of central Africa. It is expected that another member of the staff will shortly proceed for study and the collection of material to Kindia in French equatorial Africa, where the Pasteur laboratory is established.

The three divisions of activity in comparative psychobiology are planned to supplement each other. In the academic center at New Haven data will be assembled and studied in the light of their bearing upon problems of human conduct. At the Florida station, apes will be observed over long periods of time under carefully controlled conditions, and animals will be bred for use in the New Haven laboratories and elsewhere. In the field camps added data concerning the natural history of the same type of animal will be gathered.

THE CHEMICAL LABORATORY AT THE UNIVERSITY OF NEW HAMPSHIRE

THE exercises which will formally open Charles James Hall, the new chemistry building at the University of New Hampshire, will take place at 10:00 o'clock on Saturday, November 9. The exercises are to be held in Murkland Auditorium.

President Edward Morgan Lewis will act as chairman of the exercises. The program is as follows:

Dr. Lester A. Pratt: "Charles James—Teacher."
Dr. Irving C. Langmuir: "Charles James—Chemist."
Dr. H. C. Knight: "Relation of Chemistry to Agriculture and Biology."
Dr. Charles L. Parsons: "The Laboratory—the Key to Progress."

After the exercises, luncheon will be served to the invited guests. The laboratory will be open for inspection during the day.

In the afternoon the regular November meeting of the Northeastern Section of the American Chemical Society will be held in Durham. The speakers will be President Irving Langmuir and Professor Worth H. Rodebush. President Langmuir's subject has not been announced. Professor Rodebush will describe researches on the magnetic properties of the rare earths and other transition metals.

James Hall is named in honor of the late Professor Charles James, formerly head of the chemistry department at the university, who attained world-wide recognition for his work in the field of rare earths.

THE DE LAMAR LECTURES AT THE JOHNS HOPKINS UNIVERSITY

THE following series of De Lamar lectures in hygiene at the School of Hygiene and Public Health of the Johns Hopkins University is announced for the session of 1929–30:

November 12. Park Lewis, M.D., vice-president, National Society for Prevention of Blindness, Buffalo, New York, "The Adventure of Sight-saving."

December 3. E. L. Bishop, M.D., commissioner of public health, Nashville, "Tennessee's Child Health Program."

December 17. Stewart Paton, M.D., lecturer in psychiatry, the Johns Hopkins University, "The Art of Living."

January 7. H. Gideon Wells, M.D., professor and chairman of department of pathology, director, Otho S. A. Sprague Memorial Institute, University of Chicago, "The Relation of Heredity to Human Cancer."

January 21. A. S. Warthin, M.D., professor of pathology and director of the pathological laboratory, University of Michigan, "The Distribution of Latent Syphilis in the Population."

February 4. M. E. Barnes, M.D., field director, International Health Division, Rockefeller Foundation, "Problems or Duties of a County Health Officer."

February 18. Peter Olitsky, M.D., associate member, Rockefeller Institute for Medical Research, "Studies on the Bacteriology of Epidemic Influenza."

March 4. Henry F. Helmholz, M.D., professor of pediatrics, Mayo Foundation, "Preventive Pediatrics."

March 18. Henry B. Ward, Ph.D., Sc.D., professor of zoology and head of the department of zoology, University of Illinois, "The Introduction and Spread of the Fish Tapeworm in the United States."

April 22. George F. McCleary, M.D., medical officer, ministry of health, England, "Health Insurance."

DEGREES CONFERRED BY COLUMBIA UNIVERSITY

ON the occasion of the celebration of the hundred and seventy-fifth anniversary of the foundation of Columbia University, honorary degrees were conferred by President Nicholas Murray Butler on 123 alumni and members of the faculty. The doctorates of science included:

ALUMNI

Walter Hull Aldridge, E.M., 1887, engineer.

Edwin Howard Armstrong, E.E., 1913, radio engineer.

Walter Jarvis Barlow, A.B., 1889; M.D., 1892, physician.

Frederick Mark Becket, A.M., 1899, president of Electro-Chemical Society.

William Clarence Braisted, M.D., 1886, surgeon-general U. S. N., retired.

Arthur Smith Dwight, E.M., 1885, engineer.

Daniel Edward Moran, C.E., 1884, engineer.

Sylvanus Albert Reed, A.B., 1874; E.M., 1877; Ph.D., 1880, engineer.

Edward Sapir, A.B., 1904; Ph.D., 1909, professor of anthropology and general linguistics in the University of Chicago.

Bailey Willis, E.M., 1878; C.E., 1879, emeritus professor of geology in Stanford University.

Hans Zinsser, A.B., 1899; M.D., 1903, professor of bacteriology and immunology in Harvard University.

FACULTY

Leo Hendrik Baekeland, B.S., Ghent, 1882, honorary professor of chemical engineering.

Charles Peter Berkey, B.S., Minnesota, 1892; Ph.D., 1897, professor of geology.

Maurice Alpheus Bigelow, B.S., Ohio Wesleyan, 1894; Ph.D., Harvard, 1901, professor of biology and director of the school of practical arts.

Franz Boas, Ph.D., Kiel, 1881, professor of anthropology.

Marston Taylor Bogert, A.B., Columbia, 1890, professor of organic chemistry.

Gary Nathan Calkins, B.S., Massachusetts Institute of Technology, 1890; Ph.D., Columbia, 1898, professor of protozoology.

William Campbell, B.S., Durham, 1898; Ph.D., Columbia, 1903, Howe professor of metallurgy.

Henry Edward Crampton, A.B., Columbia, 1893; Ph.D., 1899, professor of zoology.

William Darrach, A.B., Yale, 1897; M.D., Columbia, 1901, professor of clinical surgery and dean of the College of Physicians and Surgeons.

Bergen Davis, B.S., Rutgers, 1896; Ph.D., Columbia, 1901, professor of physics.

Robert Almer Harper, A.B., Oberlin, 1886; Ph.D., Bonn, 1896, Torrey professor of botany.

Douglas Wilson Johnson, B.S., New Mexico, 1901; Ph.D., Columbia, 1903, professor of physiography.

Cassius Jackson Keyser, B.S., Missouri, 1892; Ph.D., Columbia, 1902, Adrian professor emeritus of mathematics.

Frederick Schiller Lee, A.B., St. Lawrence, 1878; Ph.D., Johns Hopkins, 1885, professor of physiology.

Charles Edward Lucke, B.S., College of the City of New York, 1895; Ph.D., Columbia, 1902, professor of mechanical engineering.

James Alexander Miller, A.B., Princeton, 1893; M.D., Columbia, 1899, professor of clinical medicine.

Alfred Owre, D.M.D., Minnesota, 1894; A.B., 1910; M.D., Hamline, 1895, professor of dentistry and dean of the faculty of dentistry.

Walter Walker Palmer, B.S., Amherst, 1905; M.D., Harvard, 1910, Bard professor of the practice of medicine.

George Braxton Pegram, A.B., Trinity (N. C.), 1895; Ph.D., Columbia, 1903, professor of physics and dean of the faculty of engineering.

Henry Hurd Rusby, M.D., University Medical College of New York, 1884, professor of materia medica and dean of the College of Pharmacy.

Henry Clapp Sherman, B.S., Maryland Agricultural, 1893; Ph.D., Columbia, 1897, Mitchill professor of chemistry.

David Eugene Smith, Ph.B., Syracuse, 1881; Ph.D., 1887, professor emeritus of mathematics.

Joseph Russell Smith, B.S., Pennsylvania, 1898; Ph.D., 1903, professor of economic geography.

Edward Lee Thorndike, A.B., Wesleyan, 1895; Ph.D., Columbia, 1898, professor of education.

Frederick Tilney, A.B., Yale, 1897; M.D., Long Island College Hospital, 1903; Ph.D., Columbia, 1912, professor of neurology and neuro-anatomy.

Allen Oldfather Whipple, B.S., Princeton, 1904; M.D., Columbia, 1908, professor of surgery.

Edmund Beecher Wilson, Ph.B., Yale, 1878; Ph.D., Johns Hopkins, 1881, Da Costa professor emeritus of zoology in residence.

Robert Sessions Woodworth, A.B., Amherst, 1894; Ph.D., Columbia, 1899, professor of psychology.

IN HONOR OF MME. CURIE

MME. MARIE SKLODOWSKA CURIE was the guest of St. Lawrence University, Canton, New York, on October 26 and 27. She dedicated the Hepburn Hall of Chemistry, which is the gift of Mrs. A. Barton Hep-

burn, of New York City. There is a statue of Mme. Curie over the door of Hepburn Hall. Preceding the dedication there was a service in Gunnison Memorial Chapel, at which Dr. Richard Eddy Sykes, president of the university, conferred the honorary degree of doctor of science upon Mme. Curie. An address was delivered by Dr. George B. Pegram, dean of the college of engineering of Columbia University, and an original poem in honor of Mme. Curie was read by Dr. Charles Kelsey Gaines, professor of English literature at St. Lawrence University. At the dedication service the building was presented by Mrs. Hepburn, a trustee of the university, and was accepted by Mr. Owen D. Young, president of the university corporation. Mme. Curie then read a speech of dedication.

On October 30 Mme. Curie received from the hands of Mr. Hoover a gift of $50,000 with which to purchase a gram of radium. The presentation was made at the auditorium of the National Academy of Sciences Building.

Dr. Vernon Kellogg, permanent secretary of the National Research Council, presided and introduced Dr. William H. Welch, of the Johns Hopkins University, who spoke on behalf of the scientific men of America. Mr. Hoover was then introduced and said:

I am sure that I represent the whole American people when I express our gratification to Mme. Curie that she should have honored our country by coming here. We give to her the welcome for the beneficent service she has given to all mankind.

It is not necessary for me to recount the great fundamental discovery associated with the names of her late husband and herself. The discovery of radium was an outstanding triumph of research in the realm of pure science.

It was indeed a great and successful exploration into the unknown, from which a new truth has brought to the world a practical revolution in our conceptions of substance. It has advanced all thought on the constitution of matter. And, like all discoveries of fundamental substance and fact, it has found application to human use. In the treatment of disease, especially of cancer, it has brought relief of human suffering to hundreds of thousands of men and women.

As an indication of the appreciation and the respect which our people feel for Mme. Curie, generous-minded men and women, under the leadership of Mrs. William Melony, have provided the fund with which a gram of radium is to be purchased and presented to the Hospital and Research Institute which bears her name in Warsaw. The construction of this hospital was a magnificent tribute by the city of her birth and the Polish people, in which the American people are glad to have even this opportunity of modest participation.

The whole of this occasion where we pay tribute to a great scientist is again a recognition of the fundamental importance of scientific research, and a mark of public appreciation of those who have given their lives to human service through its profession.

In reply, Mme. Curie said:

Mr. President, Dr. Welch, ladies and gentlemen:

I am conscious of my indebtedness to my friends in America, who for the second time, with great kindness and understanding, have gratified one of my dear wishes. My work is very much my life, and I have been made happy by your generous support of it.

I feel deeply the importance of what has been said by the president of the United States about the value of pure science; this has been the creed of my life. Scientific research has its great beauty and its reward in itself; and so I have found happiness in my work.

It has been, however, an additional as well as an unexpected happiness to know that my work could be used for relief in human suffering.

I do not believe that I deserve all the praise that has been given me, but I highly value the friendly feeling expressed by the president and by Dr. Welch.

Mr. President, in my native land your name is revered for having saved, by your humanitarian work, a large part of the young generation. Your kind work of to-day will add to the gratitude of the Polish people toward you.

In accepting this precious gift, which will hasten the opening of the radium institute in Warsaw, I offer you and my American friends my most profound thanks. My laboratory in Paris will keep in close relation to the Warsaw institute, and I will like to remember the American gifts of radium to me as a symbol of enduring friendship binding your country to France and to Poland.

SCIENTIFIC NOTES AND NEWS

THOMAS A. EDISON has been named an honorary member of the Italian Academy of Sciences and Letters of Genoa, in recognition of his "distinguished services to science, industry and humanity."

DR. HENRY FAIRFIELD OSBORN, president of the American Museum of Natural History, has been elected a foreign member of the Accademia Nazionale dei Lincei, Rome.

IT is reported in an Associated Press dispatch from Stockholm that the Nobel prize in medicine will be divided between Dr. Frederick Gowland Hopkins, professor of biochemistry at the University of Cambridge, and Dr. C. Eijkmann, professor of hygiene and legal medicine at the University of Utrecht. Both have worked on problems of nutrition related to what are now known as vitamins.

WE regret to learn that Dr. Harvey W. Wiley, chief chemist in the U. S. Department of Agriculture from 1883 to 1912, is seriously ill.

CORNELIUS F. KELLEY, president of the Anaconda Copper Mining Company, received the eleventh annual award of the gold medal of the Mining and Metallurgical Society of America for conspicuous services in the field of metallurgy at a reception at the Savoy-Plaza Hotel on October 22.

THE council of the Royal Meteorological Society has awarded the Symons gold medal for 1930 to Dr. G. C. Simpson, F.R.S., director of the Meteorological Office at the Air Ministry. The medal is awarded for distinguished work in connection with meteorological science, and will be presented at the annual general meeting on January 15.

PROFESSOR JOSEPH GRINNELL, of the University of California, was elected president of the American Ornithologists' Union at the closing session of the Philadelphia meeting of the society on October 21. James H. Fleming, Toronto, Canada, and Arthur C. Bent, Taunton, Massachusetts, were elected vice-presidents; Dr. T. S. Palmer, Washington, D. C., secretary, and W. L. McAtee, Cherrydale, Virginia, treasurer.

DR. ALICE H. FARNSWORTH, professor of astronomy at Mount Holyoke College, was elected president of the American Association of Variable Star Observers at its recent meeting held at Harvard University.

DR. ISRAEL S. KLEINER, professor of physiological chemistry at the New York Homeopathic Medical College and Flower Hospital, has received a grant from the Lucius N. Littauer Foundation to aid him in his studies on the blood-sugar in diabetes.

DR. W. E. GARREY, professor of physiology at the Vanderbilt University School of Medicine, has recently been elected to serve as member at large on the medical division of the National Research Council. Dr. Garrey is also a member of the executive committee of the biological division of the council.

J. REID MOIR has been elected president of the Ipswich Museum in succession to the late Sir E. Ray Lankester, in recognition of his services to science and to the museum.

THE RIGHT HONORABLE CHRISTOPHER ADDISON, M.P., has been appointed by the prime minister chairman of a committee to inquire into the question of establishing one or more national parks in Great Britain with a view to the preservation of natural characteristics, including flora and fauna, and the improvement of recreational facilities for the people.

MAX ZIMMERMANN, formerly chief chemist of the Portsmouth Dye and Chemical Company, Portsmouth, N. H., has accepted a position in the research department of the Firestone Tire and Rubber Company, Akron, Ohio.

DR. E. P. CLARK, research chemist of the Interstate Cottonseed Crushers' Association, and Dr. Herbert L. J. Haller, associate in the department of chemistry of the Rockefeller Institute for Medical Research, have accepted appointment in the insecticide division of the chemical and technological research unit of the bureau.

DR. LOUIS C. FLECK, chemist in the section of derived products at the U. S. Forest Products Laboratory, Madison, Wis., has joined the research staff of the Kimberly-Clark Corporation at Kimberly, Wis., where he will be in charge of organic chemical research. Ervin F. Kurth, chemist in the section of derived products at the U. S. Forest Products Laboratory, left the laboratory on November 1 to join the DuPont Company at Wilmington, Delaware.

DR. SAMUEL PALKIN, who since 1911 has been engaged in research work in the former Bureau of Chemistry and subsequently in the food, drug and insecticide administration, has been appointed senior chemist in the Bureau of Chemistry and Soils to do fundamental research work on naval stores.

DR. G. A. WELTZ, of Munich, and Professor Storm, of Leyden, are making a series of balloon ascents in Upper Bavaria in order to investigate climatic phenomena.

DR. ALEXIS E. CHICHIBABIN, dean of the chemical faculty of the Polytechnical Institute, Moscow, is visiting the United States.

PROFESSOR C. H. OSTENFELD, director of the Botanical Garden and Museum, Copenhagen, Denmark, recently spent several days in Washington, giving particular attention to Alaskan plants in the National Herbarium, especially to those of Arctic Alaska. His studies were undertaken in connection with the preparation of a flora of northern Canada, a project upon which he is jointly engaged with Dr. M. O. Malte, chief botanist of the Canadian National Herbarium, Ottawa.

PROFESSOR A. S. HITCHCOCK, custodian of grasses, U. S. National Herbarium, has returned from Africa. He attended by invitation the meeting of the British Association for the Advancement of Science at Cape Town and Johannesburg. He visited Pretoria, Kimberley, Bulawayo, Victoria Falls, Fort Victoria, the Zimbabwe ruins and Salisbury. From Beira in Portuguese East Africa, he sailed for East Africa, stopping at Dar-es-Salaam and Zanzibar. Landing at Tanga (Tanganyika) he proceeded to Amani, where there is an experiment station, and then to Moshi. From the neighboring town of Marangu he ascended Mt. Kilimanjaro to the limit of vegetation (14,000

feet) and then went to Nairobi (Kenya). A trip was made to Kisumu, across Lake Victoria to Entebbe, by motor car to Kampala and Jinja, by rail back to Nairobi, with stops at Elderet, Nakuru and Naivasha. Large collections of grasses were obtained, especially in East Africa where, Mr. Hitchcock states, the conditions for collecting were the best he ever encountered.

KNOWLES A. RYERSON, in charge of the office of foreign plant introduction, in company with W. H. Alderman, head of the department of horticulture in the University of Minnesota, and W. R. Leslie, of the Dominion experimental farm, Morden, Manitoba, recently returned from a plant-collecting trip in northern Manitoba and eastern Saskatchewan. The object of this trip was to obtain wild native fruits at or near their northern limits for use in developing hardy types in this country and the prairie provinces of Canada. Among the material collected by the expedition are several types of berries, an early maturing wild grape and large-fruited gooseberri s. In addition to the native fruits a collection of ornamental and flowering plants was made.

PROFESSOR H. L. CALLENDAR, of the Imperial College of Science and Technology, delivered the Thomas Hawksley lecture of the British Institution of Mechanical Engineers on November 1. His subject was "Critical Relations between Water and Steam."

STANLEY BALDWIN opened the new building for geology at the University of Liverpool on October 21. He also unveiled a bronze tablet to the memory of Lady Herdman, wife of the late Sir William Herdman, Derby professor of natural history. On Lady Herdman's death in 1922 Sir William Herdman added to his earlier gifts the sum of £20,000 towards the cost of the new geological laboratories.

Nature reports that the Norman Lockyer lecture for 1929 of the British Science Guild will be given by Sir Walter Morley Fletcher, who will speak on certain aspects of medical research and their applications, on November 19. The guild has also established an Alexander Pedler lecture in memory of Sir Alexander Pedler, for many years honorary secretary of the guild. The lecture will be an annual one, dealing with some subject of scientific interest, and will be given outside London. The first Alexander Pedler lecture will be delivered on November 26 by Dr. G. C. Simpson on "Past Climates." It will be held under the auspices of the Manchester Literary and Philosophical Society.

AT the meeting of the subcommittee on Standardization of Symbols for Heat and Thermodynamics of the American Standards Association Symbols Project, held at Harvard University on October 12, a vote was passed in appreciation of the work of the late Professor G. A. Goodenough, of the University of Illinois, who was a member of the subcommittee.

THE will of William Herbert Rollins, of Boston, leaves a trust fund of $100,000 to the Smithsonian Institution at Washington, D. C., to continue his experiments regarding "the drag of the light medium in the magnetic field" and to provide for solving problems in physics and chemistry. The will leaves to John C. Phillips, son of Dr. J. C. Phillips, the testator's tracts of land in Wellfleet and Truro for a sanctuary for plants, birds, animals and fishes with the hope "that Mr. Phillips will try to join the lands thus making a long tract of land fronting the Atlantic Ocean which, kept free of buildings or other evidences of civilization, will be very restful. Before many years the shore will be ruined by evidences of a crude civilization unless held in this way."

THE University of Minnesota recently received a gift from the Rockefeller Foundation to help to establish a laboratory for the analysis of rocks. It is believed that the demand for chemical work on rocks will be so great that in a few years the laboratory may become self-supporting. Professor Frank F. Grout has general supervision of the work, which is to be conducted in conjunction with the petrographic laboratories of the department of geology and mineralogy. The first analytical work is to be done by Dr. Reuben B. Ellestad, formerly research assistant at Harvard University and instructor in chemistry at Tufts College. If the work increases as it is expected, there will be further appointments and probably some fellowships open to advanced students in geology and chemistry who wish to acquire skill in the chemical methods of rock analysis.

THE Daniel Guggenheim Fund for the Promotion of Aeronautics, which will have expended nearly $5,000,000 in the development of aviation by the end of the present year, will finish its work at that time. An additional donation of half a million dollars has been made to the fund by Mr. Daniel F. Guggenheim. The fund is being closed on the advice of the trustees and officers, who point out that the tasks which the fund undertook at its inception have been completed. The fund was established in January, 1926, with deeds of gift from Daniel Guggenheim totaling $2,500,000, of which both interest and principal were available for expenditure. The purposes of the fund as stated at its founding were: "To promote aeronautical education throughout the country; to assist in the extension of aeronautical science, and to further the development of commercial aircraft, particularly in its use as a regular means of transportation." From time to time after the first gift Mr. Guggen-

heim made additional gifts, and these, with the fund which established the Guggenheim School of Aeronautics at New York University, and which was not included originally, bring the fund's total to approximately $4,500,000. Of this sum nearly $2,000,000 has gone directly to schools. Special gifts and fellowships have taken $19,840; aeronautical societies $60,000, while the prizes for the safety contest will require $150,000.

Industrial and Engineering Chemistry reports that the membership of the American Institute of Chemical Engineers by a recent letter ballot overwhelmingly indicated a preference for setting the institute upon a more businesslike basis and employing a full-time business manager or executive secretary to undertake the management of the institute's affairs. It is probable that the council will take official action on that expression. This will lead to the establishment of a permanent headquarters, provided with the customary office facilities for the conduct of business. The opportunity resulting from this probable action should interest a number of those qualified, particularly progressive and active young chemical engineers, and those whom this may attract are invited to communicate with H. C. Parmelee, secretary, Tenth Ave. at Thirty-sixth St., New York City. Sufficient particulars concerning training and experience of any interested should accompany the communication in order that the council may have the fullest possible details before it in considering applications.

THE London *Times* states that the British delegates who attended the meetings of the International Council for the Exploration of the Sea which were held in London last April have published their report. It shows that the discussions ranged over a variety of practical and scientific problems connected with fishery, but perhaps those most generally interesting concerned the protection of whales. The Whaling Committee of the Council, says the report, had the advantage of having as chairman Dr. Hjort, who has wide knowledge of Arctic whaling and is well informed on the economic aspects of Antarctic whaling. The committee had also the assistance of Dr. Kemp, director of the *Discovery* investigations, who gave information on the relative numbers of mature and immature whales killed at certain tropical stations on the African coast, besides facts revealed by the work of the *Discovery* expedition. The general feeling of the committee was that, although it is not at present possible to put forward recommendations which can be said to have a strictly scientific foundation, nevertheless it "feels strongly that the enormous expansion of the whaling industry in recent years constitutes a real menace to the maintenance of the stocks of whales, and that if the expansion continues at the present rate there is a real risk of those stocks being so reduced as to cause serious detriment to the industry." The report admits that until scientific researches have reached a definite conclusion it is impossible to devise permanent measures of protection, but the committee thinks that the governments of the countries interested should, as a matter of urgency, seriously consider taking immediate temporary measures to deal with the menace. Among the measures suggested is the prohibition of killing certain species of whales, principally right whales, the protection of cows with calves and immature whales, and the prohibition or restriction of the capture of whales in certain regions, notably in the tropics.

FOR nearly seven years bird sanctuaries have been established in the royal parks in London and its vicinity. We learn from *Nature* that the occasion of the publication of the Annual Report for 1928 has been taken to review the progress made. The sanctuaries have been created at small cost and without withdrawing from the public ground to which they already had access. Development has followed on very simple lines. In certain enclosures grass has been allowed to grow, unshorn by the gardener, and additional shrubs and undergrowth such as gorse and brambles have been planted to afford cover and nesting sites for the birds. Periodical thinning is carried out where necessary in order to admit light and air, nesting-boxes and nesting-material have been provided, food is supplied during hard weather, and vermin are kept down so far as practicable. The result has been excellent from the birds' point of view, and the public shows an increasing interest in the sanctuaries and their inhabitants. Appendices to the report describe the more interesting happenings at the various sanctuaries, and give lists of breeding birds and bird visitors.

UNIVERSITY AND EDUCATIONAL NOTES

ON October 17, the University of Buffalo opened a campaign for five million dollars, to be added to its endowment fund. The campaign closed on October 29, at which time there had already been pledged a total of $5,331,670. Among the gifts were $1,000,000 from the Schoellkopf family, $500,000 from Mr. and Mrs. J. F. Schoellkopf, $500,000 from Thomas B. Lockwood for a new library building, $200,000 from William H. Crosby and his family which with previous gifts will be used to erect a building for the

school of business administration, and $125,000 from Mrs. Joseph T. Jones for the establishment of a chair of French. With the exceptions noted, practically all the remaining contributions are to be used as the university trustees see fit.

AT the annual fall meeting of the trustees of Williams College gifts for endowment totaling approximately $384,600 were announced, of which nearly $136,000 has been donated for the Williams Professorship Foundation.

MISS NANCY BARTLETT, of Olean, N. Y., has given $150,000 to Alfred University for the construction of a men's dormitory. The building will be a memorial to her father, Frank H. Bartlett, of Olean, N. Y., long a trustee of the university.

DR. J. S. BOYCE, director of the Northeastern Forest Experiment Station, has resigned, effective September 30, to join the faculty of the Yale Forest School as professor of forest pathology.

WILLIAM DUNCAN STRONG, assistant curator of North American ethnology and archeology at the Field Museum of Natural History, Chicago, has been appointed professor of anthropology in the University of Nebraska to take the place of Dr. Hutton Webster, who has leave of absence.

CHANGES of staff in the department of chemistry and chemical engineering at the University of Maine for the college year 1929–30 were as follows: H. C. White and R. N. Pollock resigned to enter industrial fields; Dr. F. J. Guerin, E. J. Bogan and E. S. Durgan were appointed as instructors. M. G. Moore, since graduation a chemist at the Geneva Experiment Station in New York, was appointed as a teaching fellow.

DR. EDWARD J. PETRY, from 1920 to 1923 professor of botany and plant pathology in South Dakota State College at Brookings, who was successively consulting botanist for the experiment station and survey botanist for the South Dakota Geological and Biological Survey during 1924–25, has recently been transferred from Hendrix College, Conway, Arkansas, where he was for three years professor and head of biology, to the headship of biology in Central College, Fayette, Missouri.

DR. GEORGE P. STEINBAUER, formerly instructor at the University of Minnesota, has been appointed assistant professor of botany at the University of Maine.

SIR WILFRED GRENFELL was installed as rector of the University of St. Andrews on November 6.

DISCUSSION

COLLECTING IN THE LOWER EOCENE

FOLLOWING in the footsteps of Granger, Loomis, Sinclair and others, it was our privilege this summer to visit the Big Horn Basin of Wyoming and search for vertebrate fossils in the Wasatch beds of lower Eocene age. The season's hunting produced hundreds of teeth, jaws, limbs and partial skeletons which pertain to such widely varied classes as the fishes, reptiles, birds and mammals, not to mention a few invertebrates.

Collecting in this formation, which is the very threshold of the Age of Modernized Mammals, generally produces fragmentary things only. Whole skeletons are exceedingly rare, but occasionally one is found: it may be a complete crocodile or coryphodont; two or three fine specimens of *Eohippus* are known; there is in existence a splendid skeleton of *Notharctus,* an ancestral primate; a magnificent skeleton of *Diatryma,* the giant bird, was found by the American Museum. Few others such as these are in our museums.

Fossil birds are always rare, and especially in the older geological horizons, therefore the finding of a fairly complete specimen of *Diatryma* (but without skull and neck vertebrae) was particularly fortunate. This new discovery will supplement our knowledge of the giant wading birds of the Wasatch, heretofore known almost exclusively from two specimens.

A detailed report can not be made until the slow work of preparing and classifying the many specimens is completed, but it is hoped that in the array of small mammals: primates, carnivores, ungulates, rodents, insectivores, etc., there may be some new varieties now unknown to paleontology. In addition to this more technical use the collection offers choice study material for students, and much of it will be placed on exhibition.

EDWARD L. TROXELL

TRINITY COLLEGE

CONCERNING THE MEDITERRANEAN FRUIT FLY

THE biological basis for the cure of most diseases of parasitic origin—whether of animals or plants—is to be found in the existence of a differential in susceptibility between the host and the parasite. In other words, the remedy in at least a large percentage of cases is a poison to both organisms, but it works somewhat more easily or quickly upon one than upon the other. Sometimes the differential is large, some-

times it is so small that the greatest of care must be exercised in the application of the remedy.

In a way of speaking, this principle of the differential in susceptibility applies not only to disease but to many other problems of economic zoology and botany. In other words, before any attempt is made at the control of an insect or plant pest, or at least some time during the attempt, there is a fundamental question that must be answered positively if the attempt is to be justified. It is the question of whether or not the cost of the remedy—in terms of all the factors involved—justifies the effort, even assuming that a cure is theoretically possible. Is the differential broad enough to justify the risks that are assumed in the application of the supposed remedy? Or are we boldly to adopt a "kill or cure" policy?

A wave of hysteria—I know of no other word for the condition—has swept over the fruit growing sections of the United States and over the agricultural bureaucrats and the entomologists of the country with the word that the Mediterranean fruit fly has appeared in Florida. Immediately government-employed entomologists by the score have descended upon that unfortunate section and have begun treating it for its ills. Nor is the effect of the resulting disturbance limited to Florida alone. As far away as the northwest border of California, at least, the tremors are registered at the seismographs of the plant quarantine stations established on the highways —to the annoyance of automobilists—in the hope of intercepting any fruit fly that might attempt to sneak around and enter by the back door. But it is Florida that has had to swallow the most bitter medicine. The state seemingly has attained somewhat to the ancient status of the leper, compelled to reside without the walls and to condemn himself by the cry of "Unclean, unclean."

The enormous funds already expended or appropriated directly by the state itself and by the Federal government in attempts to "eradicate" the insect, the imposition of quarantines preventing the marketing and movement of fruit, the consequent economic dislocation with the failure of bank after bank, resulting in monetary losses of millions of dollars, not to speak of the sociological disturbances or the costs elsewhere, these have already been the price of the remedies applied. Nor can one predict how long these costs will continue or to what heights they may mount in the future. Even should the fruit fly be for the time "eradicated"—from a biological point of view a most improbable outcome—at whatever cost, it will inevitably come again and the whole performance must again be gone through. Those who believe that any quarantine can guarantee future immunity are leaning upon a hollow reed.

Theoretically perhaps the fruit fly can be eradicated. Theoretically *any* insect can be eradicated—at a price. A country can be converted into a desert. Its inhabitants can be ruined. It can be depopulated. Theoretically any disease-producing organism can be destroyed if we are willing to destroy the host along with it. But at what a price!

The time has come when the question should be publicly asked: Is it worth the price in the case of the Mediterranean fruit fly?

There are certain questions that must be answered unequivocally and on the basis of fact and not on the basis of theory or preconceived dogmas if the bureaucrats who are behind the quarantines and other supposedly remedial measures and the entomologists who have participated in the prevailing hysteria are eventually to justify themselves for their activities and the disturbances for which they are responsible.

What reason is there—other than highly debatable theory—to suppose that any quarantine, other than one which is utterly intolerable and subversive of the rights of the mass of the people, will keep any insect such as the Mediterranean fruit fly out of the United States in the first place? It has not done so.

What reason is there to suppose that such an insect once established over a wide area in a favorable environment can be eradicated at all, little less at any cost that is economically and sociologically within reason?

What reason is there to suppose that quarantines established around such regions will have any adequate effect against a flying insect? Have such quarantines kept the European corn-borer—another recent provocative of entomological hysteria—from spreading?

What has been the actual monetary loss caused by the fruit fly of and by itself through rendering fruit unusable and on the basis of known facts what would be such loss in the regions where it could live?

What, on the other hand, has been and what will be the loss occasioned not by the fruit fly itself but by the effect of quarantines and other activities of government officials attempting to control the insect?

In other words, is the differential between grievous injury to the patient and the elimination of the disease sufficiently large to permit the unrestricted application of such poisonous but supposedly remedial methods as have been and are being applied?

It might be well if, among the many other national investigating commissions that are being appointed, one more were named to consider with a cold and critical eye the whole question of plant quarantines from biological, sociological and legal points of view. The present writer is one entomologist who believes

that the agricultural bureaucrats and the economic entomologists of the country have gone wild upon the subject and that the time has come for the whole question to be reconsidered from the ground up and some restraints applied.

G. F. FERRIS

STANFORD UNIVERSITY, CALIF.

THE MICROMETRIC MUDDLE

USE the symbol μμ and it will be variously interpreted depending upon the audience. Chemists and biologists and hence most workers in agricultural sciences will almost unanimously agree that you are indicating the unit equal to one millionth of a millimeter and will permit you to call it a millimicron or a micromillimeter—though the biologists may maintain that the term micromillimeter is synonymous with micron; physicists will be certain that you mean one billionth of the millimeter (which you do if you have pledged allegiance to the U. S. Bureau of Standards) and will smile wisely if you should call it a millimicron. They know that millimicron is the term applied to the unit equivalent to one thousandth of a micron, but contrary to the other groups they would abbreviate that by the symbol mμ, again having the sanction of the Bureau of Standards and hence (probably) most handbooks. But—and this is the sad fact—the others are also correct according to the traditional usage in their fields, and they have for their authorities most of their text-books and the dictionaries.

The state of this affair is deplorable. All micrometric terms and symbols are useless, with the exception of those of the micron and Ångström unit, unless accompanied by an exact description referring back at least as far as the micron. Otherwise one runs the risk of being misinterpreted.

The various, more or less accepted, terms are as follows: The unit representing one thousandth of a millimeter is usually called the micron (symbol, μ) but it may also be called the micromillimeter according to Webster's Dictionary and certain older biological texts. The latter term, happily, is seldom applied to this unit and it may be considered obsolete. One millionth of the millimeter is commonly represented, except by light-wave measures, by the symbol μμ. Physicists apply the abbreviation mμ. All groups agree to call it either the millimicron (favored by the light-measurers) or the micromillimeter. It is indeed fortunate that these tongue-twisting twins commonly have the same meaning. The confusion is amply completed by the acceptance, mainly by physicists, of the symbol μμ to represent the smallest unit of measure, the millionth-micron or micromicron, 10^{-9} mm.

Certainly the system should be definitely put in order. What to do about it is not so easy to decide; for though it might seem proper to insist on strict adherence to the present authorization of the Bureau of Standards it can be argued that their system is that of the physicists who are a minority and that the biologists and chemists besides being greatly in the majority use the terms and symbols most widely distributed in scientific literature. But the fact remains that the common system does not provide for the micromicron (10^{-9} mm) whereas that authorized by the Bureau of Standards is complete in this respect.

JOHN P. CAMP

UNIVERSITY OF FLORIDA

OESTRUS DURING PREGNANCY

So far as the writer is aware no cases have been reported of oestrus occurring during the period of pregnancy in the white rat and allied forms. The observation of Long and Evans[1] (1922), based upon an extended series of investigations on the rat, is that oestrus is suspended during the gestation period. From a thorough study of the vaginal smears of a great number of pregnant rats they concluded (p. 56) that, "In our experience no oestrous changes occur in the cell content of the vaginal smear during the period of pregnancy." However, they recorded two cases of animals copulating during the gestation period. Allen[2] (1922) found no instances of oestrus during pregnancy, nor did Parkes[3] (1926). The latter, however, has shown that a lactating mouse, which is suckling two or less young, may exhibit typical oestrus cycles. Animals suckling more than two do not show the rhythmical vaginal changes during the period of lactation.

During the course of some experimental work in this laboratory a series of oestrous cycles was observed in a pregnant albino rat. The animal in question was a healthy virgin female. She had been unilaterally ovariectomized several days prior to her first copulation. Five days later she again came into oestrus and copulated. Thereafter for four successive cycles her vaginal content exhibited the typical cornified cell picture on every fourth day; further copulation was observed on two of these occasions. We had no suspicion of her actual condition since her size at no time approached that of the ordinary pregnant rat. The usual "placental sign" on the thirteenth or fourteenth day also was lacking. However, on the evening of the twenty-first day after the initial copulation she gave birth to five healthy young.

1 "The Oestrous Cycle in the Rat and Its Associated Phenomena," The Memoirs of the University of California, Vol. 6, 1922.

2 Edgar Allen, "The Oestrous Cycle in the Mouse," *American Journal of Anatomy*, 30: 297, 1922.

3 A. S. Parkes, "Observations on the Oestrous Cycle of the Albino Mouse," *Proceedings of the Royal Society, B*, 100: 151, 1926.

The cycles through which she passed are outlined below with the attendant events in parentheses:

Oestrus: (copulated); fifth day: oestrus (copulated); ninth day: (oestrus); thirteen day: oestrus (copulated); seventeenth day: oestrus (copulated); twenty-first day: (oestrus) (parturition).

Her vaginal smears were observed during the period of lactation, but at no time while the young were suckling were the cyclic changes found. Three days after removal of the litter she came into oestrus, but no further fertile copulations were obtained.

It is of interest to note that not only were the corpora lutea of pregnancy unable to inhibit oestrus (it is, of course, a matter of conjecture as to whether ovulation occurred or not) during the pregnant period, but also that the cervical stimulation by the vaginal plug of the initial copulation also failed to prolong the diestrous interval. Ordinarily, even infertile copulations induce a condition of pseudo-pregnancy, which lasts from ten to twelve days, through the medium of the cervical stimulation and its attendant effect upon the corpora lutea.

WARREN O. NELSON
ZOOLOGICAL LABORATORIES,
STATE UNIVERSITY OF IOWA

ALCALIGENES ABORTUS FROM THE SPINAL FLUID

Alcaligenes abortus, the cause of undulant fever in the United States, has been reported as having been isolated from the blood, urine, feces, tonsil, joint fluid, lymph gland and ovarian cyst. No report of the isolation of this micro-organism from the spinal fluid has come to my attention. Recently, I have isolated the porcine variety from the spinal fluid in a case of suspected infantile paralysis occurring in a child two and one half years of age.

FREDERICK W. SHAW
MEDICAL COLLEGE OF VIRGINIA, RICHMOND

REPORTS

THE NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

THE twenty-fifth annual New England intercollegiate geological excursion was held in the vicinity of Littleton, N. H., October 11 and 12, 1929. Fifty-two persons were present, representing sixteen institutions. The excursion was arranged and directed by I. B. Crosby, geologist of the New England Power Association.

Friday afternoon, October 11, the members of the excursion assembled at Barnet, Vt., and drove by automobile to the east end of the lower dam being erected by the New England Power Association at Monroe, N. H. Fifteen Miles Falls has a total drop of 320 feet. The lower dam at Monroe will utilize approximately 160 feet of the fall. By excavating a gorge forty feet deep in the schist at the lower dam and by creating a tail-race of fifteen feet the effective head is increased to 215 feet. The upper dam between Waterford, Vt., and Littleton, N. H., will be approximately 160 feet high, making a total head of 375 feet. The project involves the expenditure of between $30,000,000 and $40,000,000. The lower dam will create a lake of 1,100 acres and the upper dam a lake of 3,300 acres. Four units of 50,000 horse-power each will be installed at the two dams and at peak load will be able to deliver 300,000 horse-power.

Excavation at the eastern end of the lower dam at Monroe had revealed four separate glacial deposits, a lower till of normal texture overlain by deltaic deposits merging westward into varve clays. A second till was deposited unconformably on the sands and varve clays and contains a large amount of clay derived from the erosion of the underlying varved clays. Overlying the second till were the second deltaic sands, forming a capping terrace.

During the last year there has been a tendency to postulate a stagnation of the ice sheet in New England, and some have doubted whether the deposits at Bethlehem, N. H., were true recessional moraine. The erosion of the varved clays at Monroe would indicate an active rather than stagnant glacier and, since it occurs approximately in line with the Bethlehem deposits, tends to confirm the determination of a recessional moraine at that place.

At the conference on Friday evening Irving B. Crosby discussed the general geology of Littleton and Dr. J. W. Goldthwait emphasized the significance of the cuttings at Monroe in relation to the glacial history of the region.

Saturday morning the party drove to Fitch Hill and studied the fossiliferous deposits of Silurian and Devonian age at that place. A few imperfect fossils were found. Driving westward to the upper dam site at Waterford, Vt., a brief stop was made to study the terraces in the valley of the Ammonoosuc River. Lunch was eaten at the upper dam and Mr. Crosby explained that it was here the Schlumberger electrical prospecting methods had first been used to locate the buried valley of the Connecticut River. The present valley lies somewhat south of its former bed. The till filling the former course is to be utilized as an impervious barrier to which will be tied the concrete structure from the southern bank of the river.

Much of the sand of the vicinity of Fifteen Miles Falls is so rich in mica and slate that it was considered unsuitable for the concrete of the dams. Large masses of trap and diabase were located at the northern end of the lower dam in Barnet and are being utilized in large quantities in the concrete construction. During the afternoon the geologists spent an interesting period deciphering the relations of the igneous rocks at this quarry. Four types are present, a coarse diabase, two traps of intermediate and fine grain and an aplitic granite. The pyroxenes of these rocks have been largely altered to hornblende. The coarse diabase has been further metamorphosed by the alteration of its plagioclase feldspars to albite and zoisite and the fine traps have developed a schistosity accompanied by the production of much chlorite. There was a vigorous discussion concerning the relative ages of the coarse diabase and the traps, but it was generally agreed that the alteration of these rocks had been largely influenced by the later intrusion of the aplitic granite.

Saturday evening R. J. Lougee discussed his recent study of the Connecticut valley lake stretching from Middletown, Conn., to Beecher Falls, near the Canadian boundary. The deltaic terraces bordering this lake have been tilted since their deposition at the close of the Pleistocene from an altitude of 160 feet near Middletown, Conn., to an altitude of 657 feet at Hanover, N. H. The dam holding back this first lake broke, perhaps at the White Rocks Narrows near Middletown, lowering the lake approximately one hundred feet. A second lake surface can be traced northward from Hanover at an elevation of 565 feet to Beecher Falls at an altitude of 1,080 feet. Comparing the isobases of the Atlantic beaches along the New England coast with the lake terraces it would appear that the lake level was approximately 180 feet above the surface of the ocean at the time of its formation.

Sunday morning a number of the party visited the site of the future power plant which is being erected below the lower dam. Throughout the excursion the New England Power Association extended every courtesy to the geologists. Mr. A. C. Eaton, chief hydraulic engineer for the association, was specially helpful. All who took part in the excursion were much impressed by the magnitude of the undertaking and by the interesting geologic facts revealed in the large excavations.

W. G. FOYE,
Secretary

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A USEFUL MODIFICATION OF AMANN'S MEDIUM

IN the belief that any promising method develops into more certain usefulness when generally known, I wish to add an additional point to Mr. Linder's timely note on Amann's lacto-phenol-cotton blue medium. During the past two years, since he brought it to our attention, this medium has been used with success in this laboratory by the students and myself for making temporary and permanent mounts of a great variety of materials. Its combined killing, clearing and staining action, rapid restoration of normal turgor and fixation *in situ* of easily disattached spores, are marked advantages over glycerine or glycerine jelly media. Cotton blue, however—although bringing out more structures than eosine—does not usually differentiate nuclei. To meet this difficulty I tried various nuclear stains that would mix with Amann's formula. The addition of a very little Nigrosin (water soluble), either aqueous, or in saturated picric acid as described by Curtis and Colley in the *American Journal of Botany,* for February, 1915 (with subsequent filtration or settling if necessary), was found to differentiate nuclei as well as other cell structures in a considerable number of representative fungi and algae.

Moreover, with sections of host plants invaded by mycelium of such fungi as the downy mildews, a prolonged stay in the medium yields a differentiation of the host and parasite like that resulting from the more complicated treatment with lacto-phenol-cotton blue and safranin described by Lepik in *Phytopathology* for October, 1928.

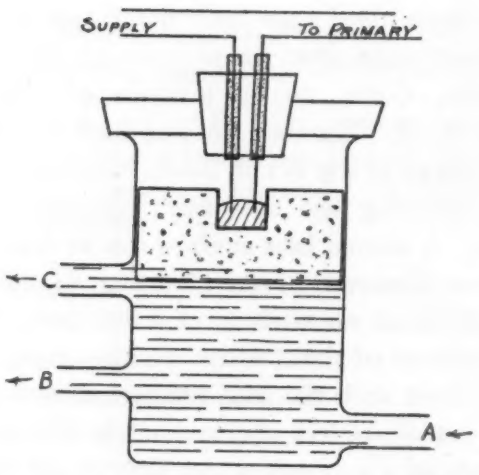
The medium lends itself well to making permanent mounts either by the double cover-glass method of Diehl (SCIENCE, p. 276, 1929), or by the older but quite reliable method described by Bullard in the *Transactions* of the American Microscopical Society in April, 1921, provided one exercises the same scrupulous care to insure perfect sealing (preferably with King's cement) that is necessary when mounting in glycerine. When making permanent mounts in very damp weather, as during a tropical rainy season, it is advisable, before sealing, to concentrate the medium on the slides in a desiccator.

WM. H. WESTON, JR.
LABORATORIES OF CRYPTOGAMIC BOTANY,
HARVARD UNIVERSITY

A CIRCUIT BREAKER FOR WATER-COOLED X-RAY TUBES

A RECENT issue of the *Journal of the Optical Society*[1] contains the description of a device for pro-

[1] L. W. McKeehan and L. M. Kirkpatrick: *Journal Opt. Soc.*, April, 1929.



tecting water-cooled X-ray tubes from failures of the water line, the operation of which depends on the outflow from the tube. A device actuated by the water flowing out of the X-ray tube was constructed by the author and used at Cornell University in 1926–1927. Inasmuch as the arrangement used is much simpler in construction than the one described in the journal, and quite efficient, it seemed worth while to give its description here.

A beaker having three tubes sealed to it is placed in the path of the water from the X-ray tube, the water entering the beaker through tube A (see figure). The diameter of tube B is slightly smaller than that of A, and can not carry the outflow. The water in the beaker rises to the level of the large tube C raising a cork plug with a mercury cup in the center. In this position two copper electrodes passing through the cover of the beaker dip into the mercury and close the primary circuit of the transformer. It is, therefore, impossible to operate the tube without turning the water on. In case of failure of the water system the level of the water in the beaker drops and with it the plug with the mercury cup, thereby breaking the primary circuit. Temporary fluctuations of the water pressure will not affect the circuit, as it takes a few seconds for the water level to drop so low as to break the circuit owing to the small diameter of tube B. It is necessary to make the wooden plug waterproof and to prevent its swelling. This is accomplished by keeping the plug in boiling paraffin for about an hour. The copper electrodes are sealed into glass tubes passing through a rubber stopper in the cover. The level of the electrodes is easily adjusted by pushing the glass tubes in or out of the stopper.

A. A. BLESS

UNIVERSITY OF FLORIDA

SPECIAL ARTICLES

VITAMIN B DEFICIENCY IN NURSING YOUNG RATS AND LEARNING ABILITY[1]

INNUMERABLE experimental studies have established the causal relationship between deficient diets and various forms of physical deformities. Howe[2] has produced experimentally in monkeys the most striking cases of tooth and nasal deformities resembling those often seen in human beings simply by placing the young and rapidly growing animals on a diet partially deficient in vitamins.

Similarly, diets deficient in vitamin B experimentally produce polyneuritis in young adult animals and play an important rôle in the etiology of pellagra and beriberi of human beings. These experiments show that the relation also exists between diet and the nervous system. However, thus far there has been practically *no* adequate experimental study on the relation of diet to learning ability.

It was the purpose of our investigation to determine the effect of various deficient diets upon the learning ability of the first, second and succeeding generations of rats of known heritage, and to correlate these findings with the anatomical and chemical changes in their nervous system.

The present report, however, deals only with the number of trials required to learn a standard maze by seventy-one rats of the first generation, some of which were depleted of vitamin B during their nursing period. Other data will be reported in forthcoming articles.

As it was our purpose to deplete the animals during their nursing period, we could succeed only by depleting the nursing mothers. The technique we used in giving the new-born pups a diet at first deficient and later free of vitamin B is that described by Sure,[3] who has demonstrated that the quantity of vitamin B in the milk of the nursing mother rat is proportional to the vitamin B content of the mother's diet.

Forty-three animals were thus depleted on this diet until they were strong enough to wean. The degree of depletion was, of course, subject to variation; some of the pups were depleted to a point so near death that their lives were saved with great difficulty, while others appeared quite normal all the way through except for retardation of the rate of growth. Twenty-eight other animals were used as controls, their

[1] From the Otho S. A. Sprague Memorial Institute and the departments of pathology and psychology, University of Chicago.

[2] Percy Howe, "Percy Howe's Letters," *The Dental Digest.*

[3] Barnett Sure, "Vitamin Requirements for Nursing Young, III," *The Journal of Nutrition,* 1: 139.

mothers being fed on a normal diet during the nursing period.

After the nursing period, all pups were placed on exactly the same diet and cared for in exactly the same way. The animals were frequently handled, while their body weights were taken and recorded at regular intervals.

The depleted animals at seventy days were stunted and smaller than the control animals so that it was decided to test part of them at ninety days, while the rest of them and the control animals were started on preliminary training at seventy days. This was done with a view to ascertain whether there was a permanent damage done to the nervous system or just a mere retardation in learning ability.

NUMBER OF TRIALS REQUIRED FOR MAZE LEARNING

Group	Control	Depleted	Depleted
Dietary condition	Vitamin B rich while nursing	Vitamin B depleted while nursing	Vitamin B depleted while nursing
Age on maze	70 days	70 days	90 days
Individual records	6	29	25
	7	31	25
	11	39	28
	12	40	31
	18	48	33
	19	49	34
	19	53	38
	19	69	48
	20	68	57
	24	69	73
	24	70	76
	25	70	85
	26	86	85
	27	92	92
	29	96	106
	29	99	109
	30	99	111
	31	112	113
	31	112	132
	33	124	142
	34	275	151
	34	283	
	35		
	41		
	64		
	67		
	67		
	84		
Total	866	2,013	1,594
Average	30.9	91.5	75.9
Median	28	70	76

After one week of preliminary training in the food box, the animals ran the maze once daily during the first three days, after which two trials were given a day until the problem was learned. The criterion of mastery was eight correct out of ten consecutive trials.

The incentive used was a vitamin concentrate (Wheatamin) which is rich in vitamin B. Sure's B-free food plus a certain percentage of yeast, available with water, was always in the living cage of each animal after the nursing period. Both groups were anxious to get the needed additional vitamin B. Preliminary work showed that this represented the best procedure in getting the two groups to the nearest approximation in relative strength of incentive.

The results thus obtained are presented in the table.

The average number of trials for the depleted animals tested at seventy and ninety days old are ninety-two and seventy-six respectively, as compared with thirty-one for the normal animals tested at seventy days. In other words, normal rats of seventy days old learn on the average three times better than vitamin B deficient rats of the same age, and two and one half times better than vitamin B deficient rats of ninety days old. None of the depleted animals (except three of the ninety days old) ever reach the attainment of the median of the normal group in learning, while the worst animal in the control group learns better than 47 per cent. of the depleted animals. Such large differences are statistically reliable.

The significance of our result becomes striking when compared with the findings of Anderson and Smith.[4] According to these investigators, rats fed on diets which contained incomplete protein or insufficient calories, are, on the contrary, superior to normal rats in maze learning. Evidently their stunting produced little or no harmful effect, but rather increased the incentive of the stunted animal.

This may be due to their inadequate control of incentive, to the particular kind of diet chosen and to the late stage of life at which stunting was introduced.

Hoefer and Hardy[5] correlated the intelligence quotients of public-school children with the method of feeding during their early life, and found that those children who had been breast fed from six to nine months ranked highest, the artificially fed next and the entirely breast fed for the first eighteen months lowest in their test scores. The results are only suggestive, as adequate control of diet, environment and heritage is lacking.

[4] John E. Anderson and Arthur H. Smith, "The Effect of Quantitative and Qualitative Stunting upon Maze Learning in the White Rat," *Jour. Comp. Psychology*, Vol. VI, No. 5, 1926.

[5] Carolyn Hoefer and Mattie Compton Hardy, "The Physical and Mental Growth of Breast-fed and Artificially Fed Infants," *J. A. M. A.*, 92: 615. 1929.

To recapitulate, our data show conclusively that normal rats are far superior in maze learning to rats which have been depleted of vitamin B during their nursing period. In so far as deficiency of vitamin B is etiologically associated with changes in the nervous system, our investigation has opened a new avenue in attacking the problem of the relation between nervous system and learning ability.

SIEGFRIED MAURER
LOH SENG TSAI

UNIVERSITY OF CHICAGO

SAVING TIME AND STORAGE IN BREEDING SUGAR-BEETS[1]

RECENT trials at the Utah Experiment Station have established the feasibility of producing in that region, in one year instead of two, successive seed generations of sugar-beets for breeding purposes.

In New Mexico, Overpeck[2] has reported that early seeding makes it possible to produce seed the succeeding summer without moving the beets. In Utah, fall or winter seeding can not be practiced, as the beets freeze in the ground. In attempts to breed sugar-beets, or to produce seed without breeding, two years have been required for each seed generation. Winter storage has proved to be a major problem, at least when attempted on a large scale.

In the spring of 1926, about seventy sugar-beet roots were set out to produce inbred and normal seed, which practically all of them did. Under the conditions prevailing at Logan, Utah, small amounts of selfed seed[3] were produced by bagging branches. Some of the selfed seeds from twelve plants were sown in the greenhouse during November, and the rows thinned to ten plants in the row. After the tops had made enough growth to begin to cover the ground, the plants were exposed to electric light from twilight to about 11 P. M.

The roots from one half of each row were harvested early and put in an ordinary potato cellar for a month. The other half continued to grow in the greenhouse until transplanting time. Water was withheld until the leaves were well wilted down. At this time, all the roots were set out in the field—the ones from the greenhouse first. All save two grew after being transplanted to the field. Most of them produced seedstalks and successfully matured seed. A summary of the data is given in Table I.

Out of twelve strains involving 114 beets, twenty failed to set seed—six in the half transplanted directly from the greenhouse and fourteen in the half given a storage period of one month.

TABLE I

NUMBER OF SUGAR-BEET ROOTS SET OUT IN FIELD DIRECTLY FROM GREENHOUSE, NUMBER STORED IN CELLAR ONE MONTH BEFORE BEING SET OUT, NUMBER AND PERCENTAGE PRODUCING SEEDSTALKS FROM EACH TREATMENT. ALL SEEDED IN GREENHOUSE IN NOVEMBER AND SET OUT IN FIELD IN LATE APRIL. GROWN WITH THE ASSISTANCE OF ELECTRIC LIGHT DURING THE WINTER OF 1926–27 AT LOGAN, UTAH

Pedigree No.	Roots set out		No. plants seeding		Percentage seeders	
	Directly from greenhouse	Stored in cellar one month	Directly from greenhouse	Stored in cellar one month	Directly from greenhouse	Stored in cellar one month
14	5	5	5	4	100	80
23	5	5	4	4	80	80
24	5	5	5	3	100	60
36	4	4	2	1	50	23
37	5	5	4	5	80	100
59	5	5	5	1	100	25
69	3	4	3	4	100	100
101	5	5	4	4	80	80
105	5	5	5	5	100	100
106	5	5	4	4	80	80
158	3	5	5	4	100	80
160	4	5	4	5	100	100

About four hundred beets were grown in the greenhouse, in 1928, and transplanted directly to the fields. Some of the beets were started in the greenhouse in early December and others in late January. All the early-seeded plants set seed successfully in 1928, but of the late-seeded group only a few set seed. This indicates that probably a minimum size or age or light exposure is required before the plants will seed normally.

CONCLUSIONS

(1) By seeding sugar-beets in the greenhouse in early December or sooner, by exposing the growing beets to electric light for a few hours in the evening and by transplanting the roots into the field in spring, a seed generation may be produced every year.

(2) The beets must have reached a minimum stage of maturity at transplanting time, otherwise many may fail to produce seed.

(3) Storage for one month in a cellar before transplanting failed to give any observable benefit.

GEORGE STEWART
UTAH AGRICULTURAL EXPERIMENT STATION

[1] Publication authorized by the director, May 1, 1929.

[2] J. C. Overpeck, "Sugar-beet Investigations," *New Mex. Agr. Exp. Sta. Bul.*, 162: 3–16. 1927.

[3] G. Stewart and D. C. Tingey, "A Method for Controlling Pollination of Sugar-beets," *Jour. Amer. Soc. Agron.*, 19: 126–128. 1927.

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SCIENCE NEWS

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A FLORIDA CYPRESS

A GIANT cypress with a trunk over fifteen feet in diameter may be Florida's rival to the big trees of California for the recognition as America's oldest living thing. Professor Herman Kurz, of the Florida State College for Women, has made a study of the gnarled and battered veteran, and estimates that it may be 2,000 years or more old, or even as much as 2,800 years old.

If this does not exceed the age of the great trees that are the pride of California, it is at least a highly respectable antiquity, and Professor Kurz feels that Floridians owe it to themselves to call public attention to the picturesque grandeur of their remaining groves of big cypresses, and at the same time insure their protection against thoughtless vandalism.

Before studying the big tree, Professor Kurz examined the stumps of a number of recently felled seven- and eight-foot specimens. One sample measuring seven feet proved by its ring count to be about 700 years old. It was, therefore, already a veteran when Ponce de Leon discovered Florida, and was a lusty young tree even when Chaucer wrote the Canterbury Tales.

Commenting on the fifteen-foot giant, Professor Kurz said: "The stubby top and relatively short trunk hark back to many and ancient violences. Sometime before Christ, this tree, probably solid and sound, had already attained a diameter of several feet. Then the pecky cypress fungus gnawed into its heartwood; maybe it was when Cicero orated for the cause of Rome. A hollow and weak trunk ensued. Next a violent storm wrenched off a large limb or two, so that the tree became stunted in appearance and growth. Just when the limbs crashed is also a conjecture. It could have happened when Caesar was in Gaul (55 B. C.) or during the time of Constantine, about 300 A. D. During the Norman Conquests or the Crusades it may have suffered the loss of another limb or two."

After surviving all these damages and dangers, the great tree is now in real peril. And ironically enough, its life is threatened by mere penknives. Thoughtless tourists by the hundreds inscribe their initials and more or less silly sentiments in its trunk, and these constant wounds are endangering the life of the tree. Professor Kurz advocates surrounding it with a high fence to protect it from its admirers; and he would also have Floridians undertake a campaign of public education designed to secure both a fuller appreciation of the interest and value of the big cypresses and their preservation for future generations.

THE CONSERVATION OF WHALES

WHALES, threatened with extinction through the tremendous expansion of the modern whaling industry, have found a friend in need in Norway, the nation in which about four fifths of the world's whaling is centered. Recent legislation by the Norwegian parliament represents an impressive example of self-imposed conservation and far-sighted industrial policy, says A. Brazier Howell, of the Johns Hopkins Medical School, a lifetime student of whales and their ways, and executive secretary of the Council for the Conservation of Whales.

Under the new act all Norwegian whalers are wholly forbidden to kill the right whale, one of the most valuable of all the great sea mammals and formerly one of the most persecuted. All whale cows with calves are given a similar blanket protection, and calves must also be let alone. The practice of paying whaling crews according to the number of whales taken must be discontinued, and all parts of the animals containing oil must be utilized. Illegal catches are subject to confiscation.

The law further confers taxing powers on the king, the funds obtained to be used in enforcing the legislation and in promoting research fundamental to the whaling industry. The king is further empowered to forbid all whaling in tropical waters.

"This praiseworthy and timely action by Norway should prove a cause for no little elation among those interested in maintaining a commercial supply of whales," comments Mr. Howell. "It should render much easier the task of securing international regulation of whaling."

CARP IN PONDS

CARP get the better of other fish whose waters they invade, literally by eating them out of house and home. This has been disclosed by the drainage of a small, carp-infested lake in southern Wisconsin, which was studied by Dr. Alvin R. Cahn, of the University of Illinois. His results are reported in the scientific magazine *Ecology*.

As the waters went down in the lake, all the fish were captured and counted. Out of a total of 6,006 fish, 5,891 were carp. More desirable species, like perch, black bass and pike, were notable for their absence or scarcity. By way of contrast, a similar total taken from a lake containing no carp had a good representation of several desirable game and food species.

The most notable difference between the two lakes, Dr. Cahn states, was to be seen in the plant population, which of course forms the ultimate food of all fishes. In the carpless lake there was an abundant growth of many kinds of plant life; in the carp-filled water there wasn't a weed. The restless, avid, all-eating mouths of the carp had destroyed every green thing.

The muddy bottom of the lake was entirely covered with little semi-round depressions about a quarter of an inch deep. These had been made by the carp, "mouthing" the mud to get the last traces of anything fit even for a carp to eat. Incidentally, of course, this constant stirring of the bottom effectually prevented the germination of any seed of a water plant that might have fallen into the lake, and also kept the water constantly roiled and muddy.

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BREWING IN ANCIENT EGYPT

WITH nothing more before him than an Egyptian bottle that has been empty since 3300 B. C., Professor Dr. Johannes Gruess, of Berlin, can tell whether the departed Pharaoh in whose tomb it was found liked his beer light or dark, whether he favored a brew made of barley or emmer, or whether his taste ran more daintily to wine. Fortunately for themselves and their subjects as well, distilled liquors were unknown to the kings of ancient Egypt.

It all turns on Professor Gruess' expert knowledge of yeasts. There are many different species of these active microscopic plants that put the kick in home-brew and raise the dough when the baker makes bread, and only a botanist specially trained in microscopic technique can tell them apart.

Professor Gruess had a lot of ancient bottles and jugs which had been sent to him by Dr. H. E. Winlock, of the Metropolitan Museum of Art in New York. They had been found in various ancient tombs, some of them dating back 1700 years beyond King Tut. They had been full of various fermented liquids, but these of course had evaporated, leaving a deposit of dried yeast cells and other detritus on their sides and bottoms.

By microscopic examination of this material, Professor Gruess was able to tell what the Pharaoh's brewer had used. The special kind of beer could be determined from starch grains mixed with the yeast deposit, and wines were betrayed by the presence of characteristic acid crystals. That one batch of beer had gone sour was indicated by the finding of the skins of a number of "vinegar eels."

Early Egyptian brewers and winemakers were not at all fussy. Apparently they didn't even take the trouble to strain the water they used; for Professor Gruess has found, mixed with his yeast cells, such things as tiny twigs and leaf fragments, bits of water weeds from the Nile, and wings, legs and heads of insects of various kinds, to say nothing of appreciable amounts of desert dust.

About one thing, however, they were particular. They always used the same kind of yeast, and they apparently kept their cultures pure for over 2,000 years. The elaborate ceremonies of the Hebrew purging and renewal of the leaven at Pesach give a hint of how yeast may have been cared for in old Egypt.

Professor Gruess identifies the old Egyptian yeast as a wild species that lives on certain fruits, though he regards it as more likely that it went into the Egyptian "makings" with honey that was added to the batch as sugar is added by present-day home-brewers. He regards it as a new species of *Saccharomyces,* the genus to which all yeasts belong, and in honor of the American who supplied him with his ancient bottles he has named the yeast *Saccharomyces Winlocki.*

THE NAVY'S NEW AIRSHIP

THE construction of the world's largest airship, the U. S. Navy's *ZRS–4,* began at Akron, Ohio, on Thursday, October 31, when a gold rivet was driven in the first great ring of its duralumin skeleton. The ring-laying ceremony of the new giant among lighter-than-air craft was comparable to the keel-laying of a battleship or an ocean liner.

Although the great hangar in which the airship will be built is not yet completed, there was room for 40,000 people to gather in the completed half of the building to watch the ceremonies. Six-hundred-ton doors, orange peel in shape, swung open from three-ton cotter pins at the top of the hangar as the first step in the ceremony.

When the *ZRS–4* takes the air about July, 1931, it will need 6,500,000 cubic feet of helium gas and will lift 180 tons. It will be longer, wider and more powerful than any airship the world has yet seen. A sister ship, the *ZRS–5,* will be built in the same hangar just as soon as the first large airship takes flight.

The airship frame contains a series of large rings that give the ship its cylindrical form. In the first of these rings, constructed flat on the floor of the hangar, was driven the gold rivet which will mark the highest part of the airship when it is constructed.

THE MEXICO CITY–LAREDO ROAD

LESS than 120 miles of roadway is all that will remain unopened at the end of 1929, of the new Pan-American highway between Laredo, Texas, and Mexico City, it is reported by the National Highway Commission.

It is now possible to go from Laredo, *via* Monterey, to Ciudad Victoria, capital of Tamaulipas, and by the end of the year, the road will be open to traffic, though not completed, as far as Valles, in the state of San Luis Potosi. Working north from Mexico City, the road is now open to Zimapan, state of Hidalgo, and by the end of the year, automobiles will be able to go as far as Jacala, a point farther north.

The portion between Valles and Jacala is being saved for 1930, as it is the most difficult part of the road of a very mountainous region, which will require much engineering to bring through.

South of Mexico City, the Pan-American highway goes through Puebla, a sector that is already complete, but from there on no official work has as yet been carried on. Work, however, will be begun on this southern sector in 1930. The road will lead from Puebla south to Huajuapan, and from there to the city of Oaxaca, an inaccessible region much broken up by mountains.

From Oaxaca, the road leads to Tehuantepec on the isthmus of that name, and from there to Tuxtla Gutierrez, capital of Chiapas. Then it goes to Tapachula, on the Mexican side of the Guatemala border, through a region of Chiapas but little known.

Road construction was first begun seriously in Mexico in 1925, when four state capitals, Cuernavaca, Toluca Pachuca and Puebla, were connected with Mexico City. Because the traffic on these roads is heavy, they are largely macadamized, but it is the policy of the road commission to produce long mileage at low cost until traffic is denser.

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More than 1,200 miles of highway have been opened to motor traffic in Mexico since 1925, and over 21,000,000 dollars have been spent. Gasoline consumption in 1928 was about 212 million liters. Although Mexico is one of the world's leading oil-producing countries, gasoline prices are several times higher than in the United States.

A motor trip to Mexico will be of geographical and ethnographic value to the tourist. He will pass through deserts, rich tropical villages, semi-tropical towns at a medium elevation, and then as he approaches the central state of Hidalgo, he will go higher than 10,000 feet, where it is always cold and scrub pine and oak are the only trees.

He will pass through the Huasteca region of Indians that are the puzzle of anthropologists, because they are apparently related to the Maya Indians much farther south. Then in the state of Hidalgo are the Otomies, and, around the region of the valley in which Mexico City lies, are the Aztecs. After Puebla comes Huajuapan, where Mixtec is spoken, and farther south near Oaxaca City there are Zapotec towns, while in the state of Chiapas are Indian groups related to the Mayas. Each of these Indian groups has largely retained its own language, though frequently in addition to the national Spanish; and the costume, too, varies as one passes from region to region.

ITEMS

Two new vitamins have recently been discovered by English scientists. Katherine Hope Coward and her colleagues at the laboratory of the Pharmaceutical Society, London, have published a paper describing a new vitamin which has somehow escaped notice before. Scientists do not yet know whether this new factor is necessary for the human race, but Miss Coward's experiments have proved that it is necessary for the growth of the experimental rat. No name has yet been given to this vitamin. It has been found in fresh milk, lettuce, grass, ox muscle, liver and wheat embryo. The other new vitamin has recently been described by Vera Reader, of the biochemical department, Oxford University. The original Vitamin B was said to prevent beriberi. Scientists found later that Vitamin B really consisted of at least two separate factors, and they decided to call them B1 and B2. Miss Reader now has found that in the Vitamin B of yeast there is a third growth factor which is chemically distinct from either of the other two. She suggested the name B3 for this new factor. Like B2, it can be destroyed by heat. The pellagra-preventing factor in foodstuffs, known as P–P, was also once thought to be part of Vitamin B.

A CASE of living tissue being grown outside the animal body is the growth of embryo gristle or cartilage into bone. This transformation has been accomplished by Miss Honor B. Fell, working at the Strangeways Research Laboratory in Cambridge, England. When the proper conditions of nourishment and temperature are maintained, isolated cells from animal embryos have been seen to grow and develop in the test-tube just as if they were still in the animal body. Miss Fell, using a technic similar to one devised by the late Mr. Strangeways, has thus cultivated tiny pieces of gristle from six-day-old embryos of fowl. During cultivation, they increased to more than three times their original length and developed along practically normal lines. Besides growing, these test-tube cultivations have actually manufactured a substance called phosphatase, an enzyme, which is of interest to biochemists, Miss Fell and R. Robison, of the Lister Institute, London, have reported. When the tiny pieces of gristle were taken from the embryo, they contained no phosphatase.

EPILEPTIC attacks may, to a certain extent, be controlled by a diet rich in fats such as cream, butter, mayonnaise, bacon and oil combined with a reduced quantity of sugars and starchy foods. Reporting on experiments carried on at the Chicago State Hospital, Dr. A. M. P. Saunders stated that of a group of eighty women epileptics thirty-two were much benefited by the diet. The rest of the patients were those who had some other physical disease or were mental defectives and did not respond. With this diet the fat is only incompletely broken up in the absence of carbohydrates and a large amount of acid is formed during the digestion. The diet must be estimated and adjusted for each individual case and must be under medical supervision during the treatment, since some patients require only a slight change from the normal diet, and others a much more restricted diet.

WE think of the Indian as sharp of vision, keen of hearing and swift of foot, yet many of America's aborigines were blind and stone deaf. The subject is being investigated for the American Medical Association, and preliminary results show that the growth of small, hard, ivory-like tumors in the outer ear passages prevent the entrance of sound waves. Such tumors, called osteomata, have been seen in the ear passages of Indians from Arkansas, New Mexico, the San Nicholas Island off the California coast and abundantly in Peru. Only a surgical operation could secure relief, and while some of the aborigines, especially the ancient Peruvians, were expert head surgeons, none attempted the removal of the tumors and the restoration of hearing. Tumors of this kind to-day are very rare, some ear specialists never having seen one. The cause of the growth of the ancient tumors is being investigated.

PROOF that prehistoric Indians of the Mimbres Valley, New Mexico, sometimes cremated their dead has been found beneath the floors of ancient Indian dwellings, according to a report by Dr. A. E. Jenks, who directed the Mimbres Expedition of the University of Minnesota and the Minneapolis Institute of Fine Arts, this season. The ways of these departed Indians are of exceptional interest because their pottery was the most beautiful and unusual of any made in the southwest, and yet other objects found in Mimbres ruins show no signs of extraordinary artistry or high culture. One burial found under the floor of an ancient dwelling revealed that the bones of the Indian had been broken into small fragments and burned.

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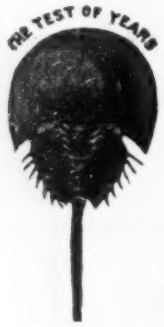

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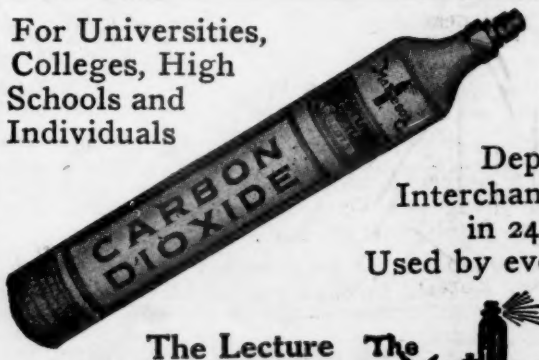

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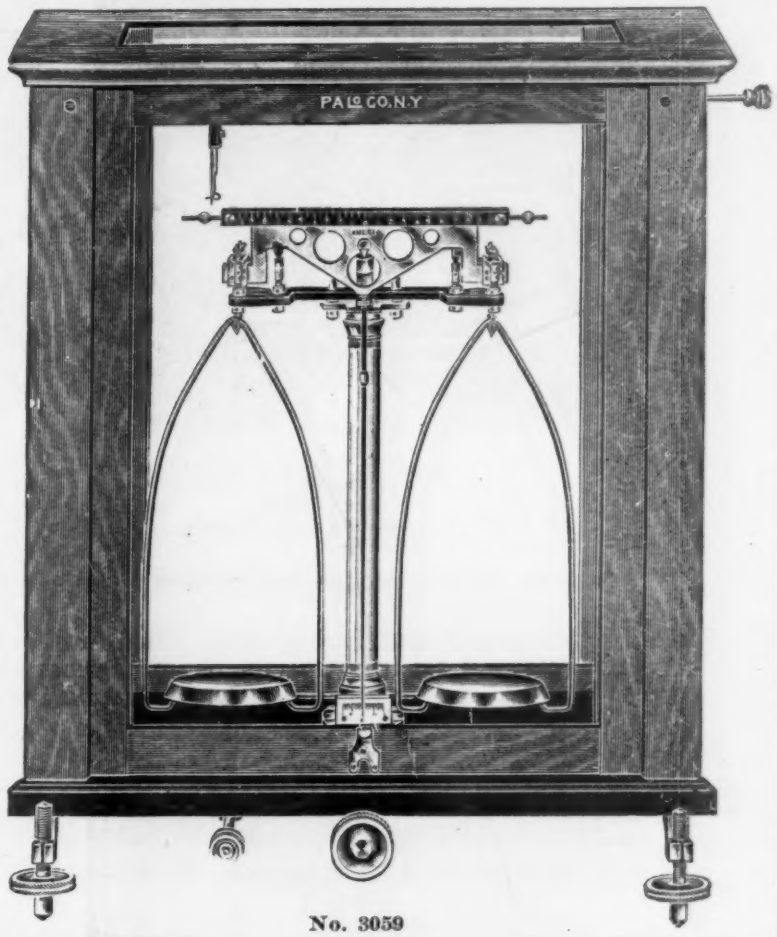

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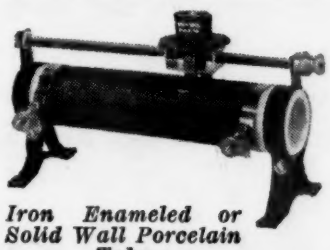

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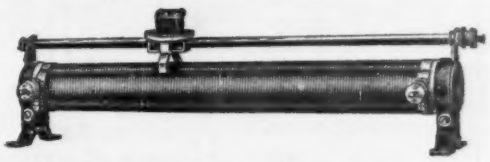

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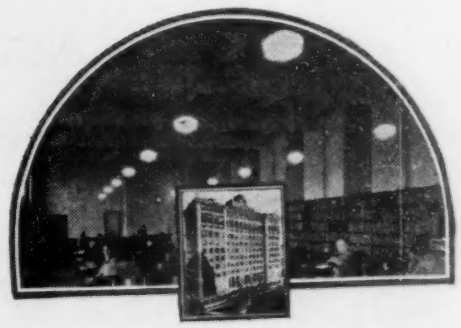

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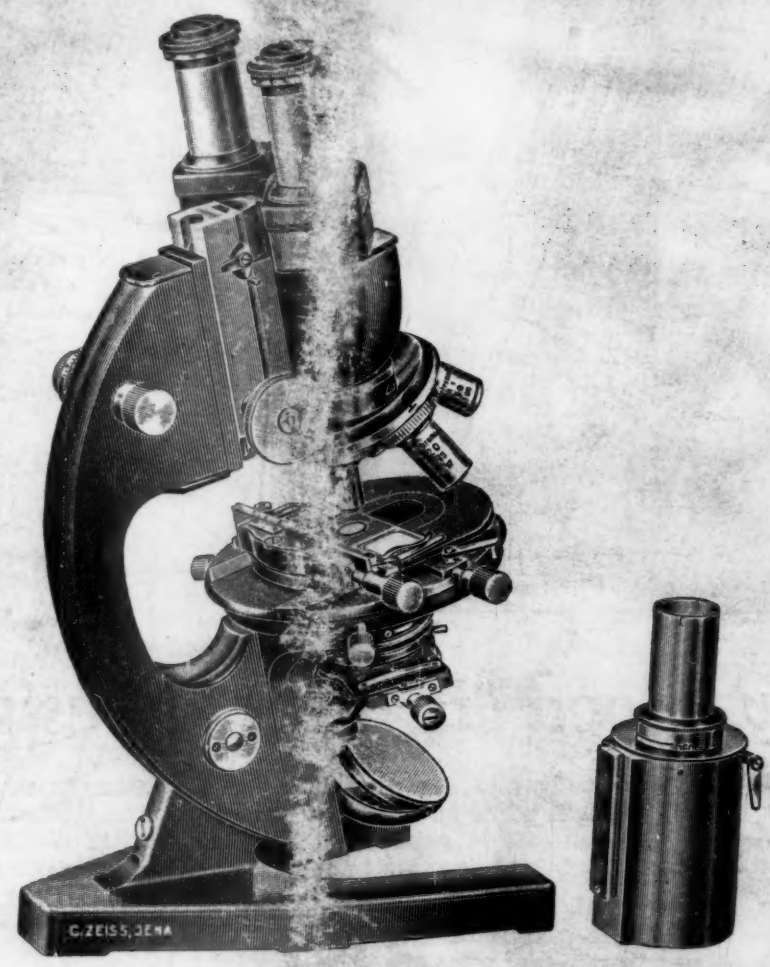

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